VOL. 73, No. 3 NOVEMBER, 1940

THE PHILIPPINE JOURNAL OF SCIENCE

MANILA
BUREAU OF PRINTING
1940

44066

THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Bureau of Science, Department of Agriculture and Commerce

[Entered at the Post Office at Manila, Philippines, as second-class matter.]

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JOURNAL OF SCIENCE

VOL. 73 NOVEMBER, 1940 No. 3

ANALYSIS AND COMPOSITION OF MANILA COPAL

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THREE PLATES AND THREE TEXT FIGURES

Manila copal is one of the prominent minor forest products of the Philippines and at present the most important of the Philippine resins.[1] It is used principally in making varnishes. The annual exportation, consisting mostly of high-grade copal, amounts to about 200,000 pesos.[2] Experiments are in progress in this laboratory to improve the quality of the low-grade copal and to convert it into useful commercial products. With proper experimentation and industrialization the Philippine copal industry could be improved and greatly extended.

Recently we devised a convenient method for the quantitative analysis of Manila copal. Samples from various Philippine provinces were analyzed and the composition determined as basic data for this line of industrial projects. The results, recorded in this paper, show that Manila copal consists mostly of resin acids together with some terpenes, resenes, and insoluble matter (alcohol insoluble). In general, the more insoluble matter there is in the copal the lower the quality.

There are two general kinds of resins, synthetic and natural. During recent years a great deal of research has been done on synthetic resins.[3] This has naturally led to a renewed interest

[1] West, A. P., and W. H. Brown, Philippine resins, gums, seed oils and essential oils. Philip. Bu. Forestry Bull. No. 20 (1920).

[2] One peso equals 50 cents United States currency.

[3] Ellis, C., The Chemistry of Synthetic Resins. 2 vols. (1935).

in natural resins. Experiments have been carried out and are still in progress to find new uses for these two kinds of resins and to make new things from them, either when used alone or mixed together.

Synthetic resins are manufactured chemically and are used in making numerous industrial commodities. The production of commercial articles from resinous materials has developed to such an extent that we now seem to be entering the age of resins.

Gibson [4] estimates the annual world output of synthetic resins to be 160,000 tons. The approximate quantities produced by individual countries are given below:

Phenolic and other synthetic resins.	Tons.	
United States	50,000	
Germany	22,000	
France	9,000	
United Kingdom	16,000	
Other countries	23,000	
Total		120,000
Cellulose acetate, nitrate, etc.		
United States	15,000	
Other countries	25,000	
Total		40,000
Grand Total		160,000

Natural resins have been used for many years in making varnishes. With the exception of shellac, which is produced by the lac insect, the natural resins are obtained as exudations of forest trees. They are also found in the ground as mineral resin which is, no doubt, a product of living or extinct vegetation.

Barry [5] states that the annual world consumption of the principal natural resins is approximately as follows:

Natural resins.	Tons.
Rosin	600,000
Copals	35,000
Shellac	35,000
Dammar	11,000
Kauri	5,000
Accroides	1,200
Total	687,200

[4] Chemistry and Industry 56 (1937) 439.
[5] Industrial Chemist and Chemical Manufacturer 14 (1938) 319.

As shown by these data the natural resins are still produced and consumed in much greater quantities than the synthetics.

For some years the American Gum Importers Association has been conducting a research and development program on the properties and application of natural resins. According to a recent report [6] from their Brooklyn research laboratory:

> The natural resin business is stable and ready to meet any demands made on it. It is not subject to decreasing supplies or vanishing source of material. Its art in varnish making is old, well established, and free from patent restrictions and the attendant difficulties of such influences. The natural resins are forest products rather than synthetic materials prepared from mineral resources. As forest products they are capable of indefinite renewal and for that reason will probably find continued use in the industry for a much longer period than their present synthetic competitors.
>
> The use of the natural resins was developed almost entirely in connection with the older varnish-making art. Varnish making for nearly a century was hedged in by restrictions, secretiveness, and close guarding of manufacturing practices. The influence of such an attitude is reflected in the relatively small amount of published information on natural resins and natural resin varnishes. . . . The natural resins deserve more attention than they have been receiving, because they offer definite economic advantages. They are cheap, readily and widely available in a large number of grades, and can be processed by modern formulations employing China wood oil and newer solvents, to give high-quality varnishes of excellent weather resistance.

Mantell and Allen [7] have determined the solubility of different classes of natural resins in numerous solvents. They state that resin solutions show no evidence of a saturation point. They simply become more viscous as the concentration of resin increases, and they are probably more like colloidal sols than true solutions.

The copals are the most important of the natural resins that are used principally for making varnishes. There are two general classes—Congo and East India, or Manila copals. The Congo variety is obtained from the Congo district in Africa. In this locality the gathering, grading, and marketing is supervised by the Copal Committee of the Association of Belgian Colonial Interests. The Belgian National Foundation for scientific research is coöperating on copal investigations which are in progress in the industrial chemical laboratories of the University of Louvain.[8]

[6] Mantell, C. L., C. H. Allen, and K. M. Sprinkel, Ind. Eng. Chem. 27 (1935) 1369.

[7] Ind. Eng. Chem. 30 (1938) 262.

[8] Ind. Eng. Chem. News Ed. (May 20, 1938).

Concerning Congo copal Mantell and Allen [9] state:

> Congo is the most insoluble of the natural resins. No solvents for it in the original state are known. Some materials swell the resin to a gelatinous mass which appears to be a transparent solution. The addition of further amounts of solvent commonly causes precipitation. After thermal processing Congo is soluble in a wide range of solvents and compatible with drying oils. These solvents include the petroleum naphthas of the simple and hydrogenated types, the varnolenes, the coal-tar naphthas, alcohols such as the butanols, and esters such as butyl acetate, terpenic solvents, ketones, ethers, the fatty acids, and the vegetable oils.

Manila copals are obtained mostly from the Netherlands East Indies, the Malay States, and the Philippines. They occur in much greater variety than those from the Congo. They are called Manila copal because originally they were exported mainly from Manila in the Philippines.

In the Federated Malay States and also in the Netherlands East Indies the copal industry is directed and controlled by government officials.

According to Foxworthy,[10] Manila copal is obtained from a large tree known botanically as *Agathis alba* (Lam.). This tree grows to a height of 50 to 60 meters and to a diameter, at breast height, of more than 2 meters with a clear length of 30 meters or more. It has an altitudinal range of 150 to 2,000 meters above sea level and attains its best development in the Philippines on well-drained slopes at 600 to 1,500 meters above sea level.

In Luzon this tree is generally distributed in Cagayan, Lepanto, Benguet, Zambales, Bataan, Camarines, Sorsogon, and Albay Provinces. It is abundant on the Islands of Mindoro, Negros, Palawan, Sibuyan, and Mindanao, being known on the last-named island from Misamis, Davao, and Zamboanga Provinces. It is found in the extreme north of Luzon and in the southernmost islands of the Philippine Archipelago.

The bark of the copal tree is rather smooth and has a grayish color. The copal resin is contained in the bark and oozes out whenever the bark is cut. It is employed locally by rural people for various purposes, such as incense in religious ceremonies, torches, starting fires, caulking boats, and as smudge for mosquitoes.

[9] Ind. Eng. Chem. 30 (1938) 265.
[10] Philip. Journ. Sci. § A 5 (1910) 173.

Doctor Freer,[11] the first Director of the Bureau of Science, recorded his observations on Philippine copal trees as follows:

An expedition from this Bureau, as early as 1903, while ascending Mount Pulgar in Palawan, camped on the side of the mountain at an altitude of about 850 meters, in the midst of a magnificent forest composed almost entirely of a growth of *Agathis alba* (Lam.), from which tree the copal of commerce is derived. We observed fresh resin, sometimes in large masses, on the sides and in the notches of the trees wherever they had been wounded, but what was especially interesting, on digging along the roots of several especially large specimens, we observed not only fairly large masses of fossil resin contiguous to them but small drops or masses of copal which had exuded from the smaller radicles extending deep into the ground. It appeared probable that all of these exudations were derived either from radicles which were dying or which had been injured in some way, perhaps by the bites of insects.

Richmond[12] says that copal resin is collected in the Philippines in the following manner:

The best results are secured by removing strips of bark about 1 meter long and 20 to 30 centimeters wide from different sides of the tree, thus offering clean surfaces for the resin to deposit as it exudes from the cut edges of the bark.

Another method of tapping practiced by the native collectors, which makes no provision for a clean surface upon which the resin may deposit and consequently gives a product which is generally mixed with chips and bark, consists in hacking a wedge-shaped place in the trunk of the tree.

The resin first appears as almost colorless tears, which soon harden on their outer surfaces. As the exudation continues, the fresh resin, instead of flowing out over the first portion produced, appears to force the latter outward by depositing beneath it; that is, the outer surface is always hard and friable. Consequently, the hardening process is extremely slow, and the size of the lumps of hardened resin collected is dependent upon the length of time it is allowed to form. In this manner it requires about two weeks to produce pieces of solid resin of marketable size. No reliable information is at hand with respect to the quantity of recent resin which is produced by a single tree in a given period, or regarding the effect of seasonal changes upon the rate of production, although the native collectors state that the resin flows best just after the rainy season.

Aguilar[13] estimates that the annual yield from individual Philippine trees varies from about 15 to 60 kilograms. Most of the local resin collected comes from Tayabas, Camarines, Palawan, and Davao Provinces. Small amounts are also collected from other provinces. In 1938 the Philippines produced

[11] Philip. Journ. Sci. § A 5 (1910) 171.
[12] Philip. Journ. Sci. § A 5 (1910) 180.
[13] Philip. Journ. For. 1 (1938) 153.

1,134,033 kilograms of copal, valued at 211,348 pesos.[14] Aguilar thinks the annual production could be increased to about five times the present output without endangering the stands of copal trees.

Copal trees are usually found in outlying districts accessible by trails. Collectors carry the resin in baskets on their backs. They are required to have a government license which is issued by the Philippine Bureau of Forestry. The tax is 1.25 pesos for every 100 kilograms of resin collected.

In the Philippines there are no standard grades for copal as each exporter has his own method of evaluation, which consists essentially in assorting the copal into lots according to solubility in alcohol, cleanliness, color, and size of the resin pieces.

Mantell and Rubenkoenig[15] carried out a special investigation on the properties of different grades of Manila copal. They determined the constants of these various grades and their solubility in different solvents. Concerning the importance of Manila copal they say:

> Manila copal at present is chiefly used in oil and spirit varnishes and paints, and also finds some applications in the manufacture of lacquers, sizing materials, plastics, japans, driers, linoleum, oil-cloth, waterproofing compositions, printing inks, adhesives, and other miscellaneous uses . . .
>
> The large supply of the resin, the known usefulness of some of its properties, and its uniform botanical origin promise the possibility that further research on the subject will be amply repaid. Supplies are sufficient to meet any demand. The collection, grading, and sorting are economic factors in the life of native populations, their consumption in the United States is a factor in the large field of decorative and protective coatings. They are not competitive with American products, and their properties are specific and individual and not shared with other resins.

The commercial grading of Manila copal was also explained by Mantell and Rubenkoenig:

> Manila resins are divided into classes according to the age of the resin. . . .
>
> The softest grades, gathered between 1 and 3 weeks after tapping, and called melengket by the natives, are exported from the Netherlands Indies in four qualities. The finest grade, PWS (prime white soft), is nearly water-white in color and almost entirely free from impurities of any sort. WS (white soft) is very clean and quite light in color. MA (or melengket A) may contain some bark and wood fiber. The latter grades are by far the most used in this country. MB (or melengket B) may contain considerable amounts of woody impurities. Currently it is not much in demand in the United States but finds outlets abroad. These soft grades arrive

[14] Ann. Rep. Insular Collector of Customs (1938).

[15] Ind. Eng. Chem. 29 (1937) 855.

on the market as blocky lumps, clear and free from any surface crust. A slightly older and harder grade is called E and is marketed in admixture with the C grade of the Loba type of Manila as Loba CNE.

Half-hard Manila, or Manila Loba, is the designation of material gathered from 1 to 3 months or more after tapping. The resin has become hard enough so that the pieces do not block together as does the soft Manila. It is scraped free of surface impurities and graded according to size of piece, from A (over 4 cm.) to D (less than 1 cm.) and dust. These are Netherlands Indies gradings. Singapore Manila is of the same type. Philippine Manila is also resin of about the same age; it is sorted according to both color and size of piece. . . .

The fossil grade of Manila is derived from the Netherlands Indies and is known as Boea or hard Manila. The light colored variety is found where it has exuded in the crotches of trees still standing. The amber and dark grades are found buried in the ground . . .

Some researches have been carried out to ascertain the composition of Manila copal.

Tschirch and Koch [16] were the first to investigate this problem. They isolated several resin acids and concluded that Manila copal consists principally of free resin acids that are amorphous. It also contains unsaponifiable matter and a volatile oil. Their method of analysis consists in dissolving the crude resin in ether and extracting successively with a 1 per cent solution of ammonium and sodium carbonates.

Concerning this method of separating the constituents of Manila copal Richmond [17] says:

The main objection to Tschirch's method of examining resinous substances is its inapplicability to resins which are not completely soluble in ether or some other solvent indifferent to aqueous alkalies. Furthermore, the difficulty of complete removal and separation of the weak resin acids from their etherial solutions with dilute solutions of ammonium and sodium carbonates renders the method extremely tedious and unsatisfactory.

Hans Wolff [18] thought that the resin acids isolated from Manila copal by Tschirch were probably not definite component substances but mixtures, and some of the acids described as isomeric are really identical and owe their differentiating characteristics to varying degrees of dispersion.

Richmond [19] devised an approximate method for separating the constituents of Manila copal. His method consists in sep-

[16] Arch. d. Pharm. 240 (1902) 202.
[17] Philip. Journ. Sci. § A 5 (1910) 185.
[18] Farben Ztg. 29 (1924) 2039.
[19] Philip. Journ. Sci. § A 5 (1910) 186.

arating the resin acids from the crude copal without first removing the terpenes and resenes. This method does not give very clean-cut separations. However, his results agree, in general, with those recorded by Tschirch and Koch.

From a perusal of the literature it appears that as yet no convenient and accurate method for analyzing Manila copal quantitatively has been reported.

EXPERIMENTAL PROCEDURE

Most of the samples of Manila copal used in this investigation were kindly presented to us by Director Tamesis of the Philippine Bureau of Forestry. These samples were collected by forest rangers working in different Philippine provinces. We also received some samples from the Aguado Hermanos Company and the F. E. Zuellig Company (copal dealers) Manila. All of this copal was the soft variety.

The terms "soft" and "hard" copals, as used by the American Gum Importers' Association, have been explained [20] as follows:

> In general, the natural resins are divided from the point of use into those which are spirit-soluble ("spirit" originally meant alcohol but now embraces a large variety of solvents) and those which are oil-soluble. The first class is generally soluble directly, while the second needs to be processed by thermal methods. The spirit-soluble resins are in general of the soft variety, while the oil-soluble are usually hard.

Preparation of copal sample for analysis.—Average characteristic samples of copal obtained from a definite location were powdered finely and the powder mixed thoroughly to produce uniform samples. Portions of the freshly powdered copal were used immediately for the analysis. The remainder was placed in amber-colored bottles which were stoppered securely and kept in a dark closet. The material was thus protected from the effects of light and atmospheric weathering.

Acid number.—The acid number is ascertained by treating approximately 1 gram of the powdered copal with 50 cc of a mixture consisting of neutral absolute alcohol and benzene (25 cc each) and titrating directly with seminormal alcoholic potassium hydroxide in the presence of phenolphthalein.

Saponification number.—For this determination approximately 1 gram of powdered copal is treated with 50 cc of absolute al-

[20] Mantell, C. L., C. H. Allen, and K. M. Sprinkel, Ind. Eng. Chem. 27 (1935) 1370.

cohol after which 25 cc of seminormal alcoholic potassium hydroxide is added. The mixture is heated on a steam bath with a reflux condenser for 2 hours. The solution is then cooled and the excess alkali titrated with seminormal sulphuric acid in the presence of phenolphthalein.

Ester number.—Ester number is the difference between the saponification and acid numbers. All the samples of copal we investigated gave ester numbers.

Data on these constants are given below. Sample A gave rather low constants while B gave unusually high results. In general, for most specimens of Manila copal the data for these constants will vary between these limits.

Constants of Manila copal.

Constant.	Sample. A.	B.
Saponification No.	142.24	209.47
Acid No.	104.55	132.97
Ester No.	37.69	76.50

Copal analysis.—A number of preliminary experiments were carried out to ascertain the most convenient method for separating the constituents in Manila copal. Some samples were entirely soluble in alcohol while others had a large amount of insoluble matter, consisting of gelatinous copal together with foreign matter such as dirt, pieces of leaves, twigs, and the like. Dirt alone is easily eliminated by dissolving the copal in alcohol and removing the dirt by filtering. Local dealers do not care to handle copal if it contains a large amount of insoluble gelatinous ingredients, as this material causes difficulty in processing this resin.

In general, Manila copal was found to consist of resin acids together with some terpenes, resenes, and insoluble matter. In analyzing copal from various Philippine provinces one may therefore expect to find the following:

Insoluble matter containing:
- Foreign material (dirt, etc.)
- Gelatinous copal

Copal soluble in alcohol containing:
- Terpenes
- Resenes
- Resin acids
- Water (determined by difference)

An outline of the method we devised for analyzing soft Manila copal is given in text fig. 1.

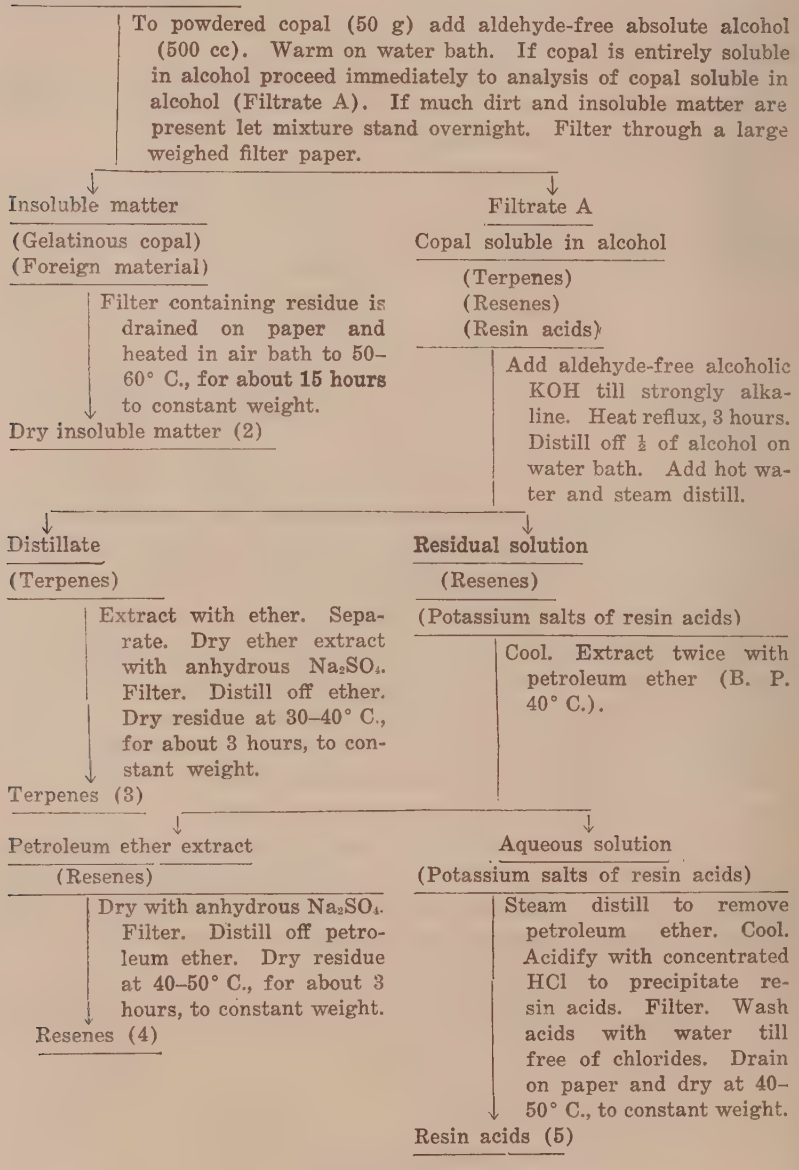


FIG. 1. Analysis of Manila copal.

According to the procedure outlined in text fig. 1 the powdered copal (1) is first treated with aldehyde-free absolute alcohol.[21]

This refined alcohol is prepared by adding to a liter of ordinary (95 per cent) alcohol 3 grams of silver nitrate and 3 grams of potassium hydroxide. After standing overnight the alcohol is decanted from the silver residue and distilled. The aldehyde-free alcohol is treated with lime, shaken thoroughly, and again allowed to remain overnight. It is then distilled to obtain the aldehyde-free absolute alcohol which was used throughout our analysis. Ordinary alcohol contains aldehydes that polymerize to form resins.

The mixture of copal and alcohol is heated on a steam bath and shaken occasionally for about a half hour. If the copal dissolves completely proceed immediately to the analysis of soluble copal (Filtrate A).

Insoluble matter.—If the mixture appears to contain a considerable amount of insoluble matter it is heated on a steam bath for about 3 hours until all the soluble copal is apparently dissolved. It is then allowed to stand overnight to facilitate the subsequent filtration; the insoluble matter, consisting of grayish, gelatinous copal together with dirt and other foreign material, gradually settles out on standing, leaving a fairly clear supernatant liquid. The mixture is filtered through a large weighed filter paper. With some samples the insoluble residue may adhere tenaciously to the flask. This substance may be loosened with a firm hooklike wire. The insoluble matter is washed with alcohol and the filtered washings are added to the soluble copal solution. The filter with the insoluble matter is allowed to drain on layers of filter paper after which it is dried in an oven at 50 to 60° C., for about 15 hours or longer until the weight of the insoluble matter (2) becomes constant. The drying may be facilitated by opening the partly dried filter and spreading the residue in a somewhat thin layer. Use of a vacuum oven also hastens the drying.

Soluble copal.—The alcoholic solution of the copal (filtrate A) is treated with an alcoholic solution of potassium hydroxide sufficient to neutralize the free resin acids and to saponify the saponifiable material contained in the copal solution.

If the sample contains very little insoluble matter the required amount of alkali to be used is ascertained by multiplying the saponification value of the copal by the amount (50 grams) of sample used for the analysis. The estimated amount of alcoholic

[21] Dunlap, F. L., Journ. Am. Chem. Soc. 28 (1906) 397.

potassium hydroxide is added with about 10 per cent excess to make the copal solution strongly alkaline.

When the sample contains very much insoluble matter the required amount of potassium hydroxide may be ascertained by saponifying an aliquot portion of the copal solution (saponification number).

After boiling the mixture (reflux) for about 3 hours to complete the saponification, approximately half the alcohol is eliminated by distilling. The alcohol distillate is set aside because it contains some terpenes. About 200 cc of hot water is added to the residue in the flask to dissolve the potassium salts and to give a clear amber-colored solution. The solution is now steam distilled to remove the terpenes. This process requires usually about 20 hours, after which the distillate runs colorless and has no more terpene odor.

To this aqueous distillate, containing terpenes, is added the alcohol obtained previously from the saponified product.

The combined distillates (in portions of about 100 cc) are extracted with ether until they no longer have a milky appearance. Generally one extraction for each portion is sufficient. The combined ether extracts are dried with anhydrous sodium sulfate. The clear ether solution is then filtered into a weighed flask and the ether distilled off. In order to drive off the last traces of ether the flask is placed in an oven and heated for 3 hours at a temperature of 30 to 40° C., or until the weight becomes constant. The residue consists of the terpenes (3).

The solution remaining in the flask after the terpenes are removed is cooled to room temperature and extracted twice with petroleum ether. Two extractions are usually necessary to insure the complete removal of the resenes which are not acted upon by the alkali. The petroleum ether extract is dried with anhydrous sodium sulfate, filtered into a weighed flask, and distilled on a water bath. The last traces of petroleum ether are removed by heating in an oven at 40 to 50° C., for 3 hours or more until the weight becomes constant. This gives the resenes (4).

The solution of potassium salts remaining in the flask is steam distilled to remove petroleum ether, after which it is cooled to room temperature and acidified with concentrated hydrochloric acid to precipitate the amorphous resin acids. The acids are filtered through weighed filter paper and washed with water until they are free of chlorides. The filter containing the acids

is allowed to drain thoroughly after which it is dried in an oven at 40 to 50° C., until the weight of resin acids (5) becomes constant. The drying may be facilitated by opening the partly dried filter and spreading the residue in a somewhat thin layer. Use of a vacuum oven also hastens the drying.

Water in Manila copal.—Soft Manila copal usually contains a small amount of water, less than 2 per cent. When blocks of this copal are cut in half the interior of some samples is really somewhat wet. The presence of water in the copal is tested by adding to the moist part a small amount of powdered anhydrous copper sulphate which almost immediately turns blue. Water in copal is conveniently determined by difference; that is, the difference between 100 per cent and the sum of the percentages of all the other constituents contained in the copal.

In Table 1 is given the composition of a number of copal samples analyzed by this method. The Philippine provinces from where they were collected are given below:

Copal sample.	Province.
1	Palawan
2	Do.
3	Rizal (Montalban)
4	Pangasinan (Luit)
5	Tayabas
6	Palawan
7	Davao (Surup)
8	Davao (Camanlongan)
9	Davao (Caburan)
10	Do.
11	Nueva Ecija (Carañgalan)

Copal constituents.—Table 1 shows that high-grade Manila copal, containing only a small amount of insoluble matter, consists principally of resin acids. It also contains some terpenes (volatile oil) and resenes (copal constituents not acted upon by alkalies). These results agree with those reported by Tschirch and Koch and also by Richmond.

The first two samples (Table 1) had about the same composition. These were duplicates taken from a single piece of clear, white copal. The others collected from different districts varied greatly in composition. All the copals had the same general constituents but the percentage of any particular constituent varied considerably in the different samples.

Pieces of copal from the same tree may vary in composition due to the ageing of the copal. Resin that has been clinging

to a copal tree for some time and has become rather hard and weathered will naturally have a composition somewhat different from soft resin very recently produced by the tree.

TABLE 1.—*Composition of Manila copal.*

Constituent.	Sample.				
	1	2	3	4	5
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Insoluble matter	0.72	1.16	1.90	6.26	9.90
Copal soluble in alcohol:					
Terpenes	16.02	14.86	10.86	16.28	15.24
Resenes	3.80	3.80	4.90	1.20	2.34
Resin acids	77.96	78.42	80.94	74.72	70.74
Water (by difference)	1.50	1.76	1.40	1.54	1.78
Total	100.00	100.00	100.00	100.00	100.00
Melting point °C	120.00	120.00	--------	132.00	120.00

Constituent.	Sample.					
	6	7	8	9	10	11
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Insoluble matter	18.12	20.30	23.06	25.00	36.46	42.62
Copal soluble in alcohol:						
Terpenes	12.10	4.50	0.58	5.12	0.46	1.80
Resenes	0.74	1.60	3.88	5.80	4.30	2.96
Resin acids	68.24	71.80	72.32	62.54	57.20	50.70
Water (by difference)	0.80	1.80	0.16	1.54	1.58	1.92
Total	100.00	100.00	100.00	100.00	100.00	100.00
Melting point °C	118.20	129.00	136.00	--------	131.50	136.00

TERPENES

The amount of terpenes in the samples of copal we analyzed ranged from 0.46 (sample 10) to 16.28 per cent (sample 4). Brooks [22] investigated the terpenes in Manila copal. He says:

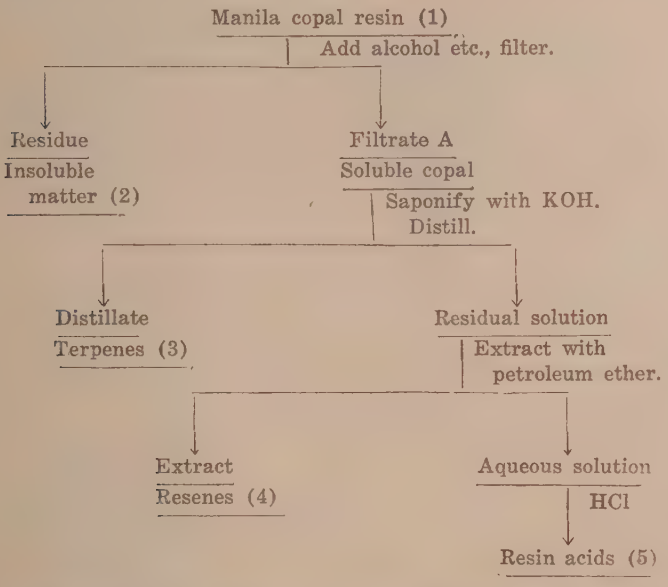
> The volatile oil from certain specimens of Manila copal appears to consist almost entirely of pinene, while others show a high percentage of limonene. The presence of limonene could not be proved in the distillates from certain samples, and if present, it exists there in very small amount.
>
> As would be expected, individual pieces of the resin vary in the percentage of volatile oils contained in them. It would probably be safe to assume that the soft, white resin, from which about 11 per cent of terpenes was obtained, is of comparatively recent origin; while the hard, brown resin

[22] Philip. Journ. Sci. § A 5 (1910) 205.

containing less volatile oil is much older. In general, very large lumps contain more volatile oil than small pieces. Large pieces which were quite hard on the surface and had a much weathered appearance were found to yield as high as 6 per cent of terpenes.

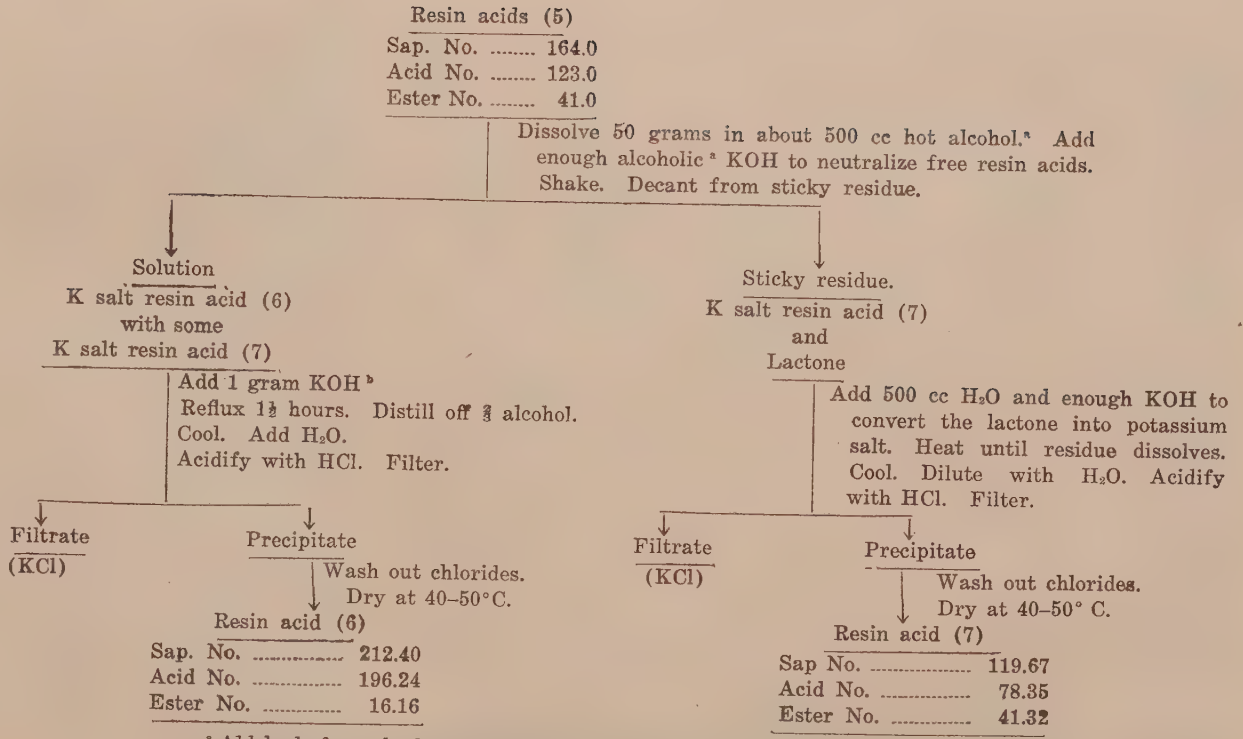
RESIN ACIDS

Resin acids (5).—As shown in Table 1, the amount of resin acids (5) in Manila copal varies from 50.7 to 80.94 per cent. Resin acids were separated from sample 1, in accordance with the procedure given in text fig. 1, which is abbreviated below.



The resin acids (5) gave the following constants: Saponification number, 164; acid number, 123; ester number, 41. As shown by these data the resin acids (5) consist of a mixture of free resin acids and a saponifiable substance. The ester number indicates that this saponifiable substance is a lactone.[23] An outline of the procedure we used for separating the constituents in this mixture is given in text fig. 2.

[23] Richmond, G. F., Philip. Journ. Sci. § A 5 (1910) 191.
Allen's Commercial Organic Analysis 4 (1925) 277.
Lewkowitsch, J., Journ. Soc. Chem. Ind. 15 (1896) 15.



[a] Aldehyde-free absolute alcohol.

[b] By boiling with KOH the subsequent precipitation of the resin acid is facilitated.

FIG. 2. Separation of resin acids (5).

As shown in text fig. 2 the resin acids (5) were dissolved in aldehyde-free absolute alcohol and the solution was made exactly neutral with aldehyde-free alcoholic potassium hydroxide in accordance with the acid number of the resin acids. The free resin acids were thus converted into their potassium salts soluble in alcohol. The lactone and the potassium salt of the resin acid (7) were precipitated as a sticky mass. By decanting the alcoholic solution, the soluble potassium salts were separated from the insoluble sticky mass. This separation, however, is not exactly complete, as the potassium salt of the resin acid (7) is slightly soluble in alcohol. Again the sticky residue tends to occlude a little of the alcohol-soluble potassium salts.

Solution (potassium salts of resin acids).—This solution contains the alcohol-soluble potassium salt of a resin acid (6) together with a small amount of the potassium salt of acid (7). The latter is only slightly soluble in alcohol. The alcoholic solution of the potassium salts of these acids (text fig. 2) was treated with a gram of potassium hydroxide and heated (reflux) for about 1.5 hours. This procedure facilitates the subsequent precipitation of the resin acids with hydrochloric acid. The mixture was distilled until about two-thirds of the alcohol was removed. The solution was cooled to room temperature and diluted with water. It was then acidified with hydrochloric acid to precipitate the resin acids, and filtered. The precipitate was washed with water until free of chlorides and dried at a temperature of 40 to 50° C.

The resin acid (6) had an ester number of 16.16 which represented the lactone contained in the acid. The potassium salt of the acid (7) when acidified is converted into acid (7) which tends again to assume the lactone formation.

Sticky residue.—When the sticky residue (text fig. 2) was treated with warm water the potassium salt of the acid (7) was dissolved, leaving the lactone as a sticky mass. By boiling the mixture with sufficient potassium hydroxide, calculated in accordance with the ester number of the resin acids (5), the lactone was converted into the potassium salt of the acid (7). When the solution of the potassium salt of the acid (7) was cooled to room temperature and treated with hydrochloric acid the crude resin acid (7) was precipitated.

The resin acid (7) had a high ester number (41.32), showing that a large amount of the acid was converted to lactone when the acid was freed from the potassium salt.

As indicated in text fig. 2, the resin acids (5) having a saponification value of 164 were separated into two acids having very different saponification values:

Resin acid (6), saponification number, 212.40;

Resin acid (7), saponification number, 119.67.

Resin acids (5) therefore consisted of a mixture of the acids (6) and (7).

Knowing the saponification values of these individual acids and the saponification value of the mixture, acids (5), we can calculate the amount of each of these acids in the mixture.

If x = acid (6)
And y = acid (7)

Then $x + y = 100$

$$\frac{212.4\ x + 119.67\ y}{100} = 164$$

From this we find the following:

Composition of acids (5):
47.81 per cent acid (6)
52.19 per cent acid (7)

100.00 per cent total

By dissolving resin acid (6) in alcohol and neutralizing the solution a second precipitation of the sticky residue may be obtained. When the filtrate from this residue is again boiled (reflux) with potassium hydroxide, the excess alcohol removed by distilling, the solution diluted with water, and then acidified with hydrochloric acid there is obtained a second precipitation of resin acid (6). By this procedure more of the resin acid (7) is removed from resin acid (6). The ester number of acid (6) is thus considerably reduced.

As a check on the characteristics of the resin acid (7) a sticky residue was obtained from another sample of copal by the same procedures (text figs. 1 and 2). It was treated with warm water to dissolve the potassium salt of the acid (7) and then filtered to separate the soluble salt from the sticky lactone. This is a slow process, as the sticky lactone tends to clog the filter.

From the solution of the potassium salt the acid (7) was obtained by precipitating with hydrochloric acid. When the sticky lactone was saponified and converted into the potassium salt of the acid (7) and this reaction product acidified with hydro-

chloric acid, the resin acid (7) was also precipitated. The constants of these acids are given in the outline below.

Sticky residue
K salt of resin acid (7)
Lactone
↓ Treat with warm H_2O. Filter.

Solution		Sticky residue	
K salt resin acid (7)		Lactone	
↓ HCl		↓ Saponify with KOH	
Resin acid (7)		K salt resin acid (7)	
		↓ HCl	
		Resin acid (7)	
Saponification No.	121.26	Saponification No.	124.11
Acid No.	73.00	Acid No.	64.45
Ester No.	48.56	Ester No.	59.66

Since both of these acids were derived from the potassium salt of the resin acid (7) they naturally have about the same saponification numbers, within experimental limits, and are identical. Both acids had high ester numbers, showing again that when the resin acid (7) is liberated from its potassium salt it tends to be converted into the lactone formation. Although obtained from a different sample of copal these acids are identical with the resin acid (7) (text fig. 2). The saponification values of these acids are slightly higher than that of resin acid (7), due to the fact that some resin acid (6) was occluded in the sticky residue during the separation of these products. This would naturally raise the saponification value of the acids obtained from the sticky residue.

We isolated the lactone from the sticky residue (text fig. 2) by treating the latter with warm water which dissolved the potassium salt of the resin acid (7). The insoluble lactone was finally removed by filtering. The lactone, when isolated and dried, was found to be very slightly soluble in methyl alcohol and acetone but insoluble in all the other common organic solvents.

Resin acids from resenes.—The resenes (4) were separated from Manila copal in accordance with the procedure given in text fig. 1. The copal, soluble in alcohol, was treated with al-

coholic potassium hydroxide which converted the resin acids into their potassium salts. The mixture was then steam distilled to eliminate the terpenes. The residual solution was cooled and extracted with petroleum ether to obtain the resenes.

The resenes in Manila copal (Table 1) ranged from 0.74 (sample 6) to 5.8 per cent (sample 9). Like the terpenes these substances when present in copal are not acted upon by alkalies, and this characteristic is said to enhance the value of copal for the manufacture of varnishes.

Separated from the copal, the resenes consisted of a clear, transparent, sticky mass. Those from some samples had a green color suggestive of chlorophyll. However, on exposure to light the color gradually faded out.

Allowed to stand for some months a composite sample of the sticky resenes was gradually changed to an amorphous substance which was slowly converted to a brittle resin (8) (text fig. 3). We found that this transformation could be facilitated by allowing the sticky resenes to stand until they gradually changed to the amorphous condition and then boiling them with water. The brittle resin thus obtained was removed from the water and dried. It gave the constants shown below.

Brittle resin (8) from resenes (4): saponification number, 194.16; acid number, 155.45; ester number, 38.71.

This brittle resin not only resembled ordinary copal in appearance but it could be saponified and gave high acid and saponification numbers. It was investigated in accordance with the procedure for copal analysis (text fig. 1). After saponification it was steam distilled, yielding a very small amount of a volatile liquid. This liquid resembled the terpenes (3) obtained directly from the copal as it gave a milky solution in water. However, the odor was quite different.

The residual solution after steam distillation gave a small amount of petroleum-ether extract. This material resembled the resenes (4), obtained directly from the copal. It was quite sticky and had the characteristic fresh resene odor.

Most of the brittle resene resin was converted to the resin acids (9) (text fig. 3), which had the constants given below:

Resin acids (9) from brittle resin (8): saponification number, 192.26; acid number, 176; ester number, 16.26.

Like the resin acids (5) the acids (9) consisted of a mixture of free resin acid and a saponifiable substance (lactone) indicated by the ester number. There was not enough material to

separate quantitatively the resin acids (9) into their component constituents and to obtain the constants of the latter. However when a small amount of this material was dissolved in alcohol and neutralized, a sticky residue and an alcohol-soluble portion were obtained as in the case of acids (5).

Resin acids from insoluble matter.—The portion of Manila copal that does not dissolve in ethyl alcohol we designated as insoluble matter. When copal is treated with hot alcohol the soluble part dissolves. Insoluble matter, if present, may consist of a grayish, gelatinous mass that usually contains some foreign matter, such as dirt, and perhaps pieces of leaves and twigs. The insoluble matter is allowed to settle overnight and is then separated from the copal solution by filtering. When the filter containing this material is heated in an air bath to a temperature of 50 to 60° C., the gelatinous copal undergoes various changes. It is first converted into a viscous, elastic material that sticks to the filter paper. The viscous material then gradually changes to an amorphous solid that can be weighed to constant weight giving dry insoluble matter (2), as shown in text fig. 1.

When the amorphous solid is allowed to stand for some time, perhaps three months or longer, it is finally converted into an impure brittle resin that can now be dissolved in alcohol and separated from foreign matter (dirt, and the like). Continued heating of the amorphous solid at 50 to 60° C., facilitates this change, especially if the material is spread in a thin layer on a tray. This transformation to a brittle resin may then require only about a week. However, the length of time varies with different samples of copal. We found that with some samples this transformation may be accomplished by simply boiling the amorphous solid with water or steaming for about three hours after which the brittle resin is drained and dried at 50 to 60° C.

These various changes from the gelatinous insoluble matter to the brittle resin are as follows:

Gelatinous insoluble matter → viscous elastic material → amorphous solid → impure brittle resin.

The gelatinous insoluble matter obtained from the copal is thus converted into a brittle resin similar to the copal. It would appear that the gelatinous material is very closely related to the copal and is probably a modified or oxidized form. The oxidation of copal will be considered in a subsequent paper.

A composite sample of the insoluble matter (2) (text fig. 1), obtained from several lumps of copal, was heated at a temperature of 50 to 60° C., until it was converted to a brittle resin.

Since this resin was obtained directly from the insoluble matter in the copal we suspected that it might contain some terpenes and resenes. The brittle resin was dissolved in alcohol and filtered to eliminate foreign material and dirt. The filtrate was analyzed like soluble copal (filtrate A) (text fig. 1). It was found to consist almost entirely of resin acids and contained only 2.2 per cent terpenes and 0.12 per cent resenes.

Brittle resin obtained from the insoluble matter in another sample of copal gave only 0.14 per cent terpenes and 0.18 per cent resenes.

We designated the resin acids separated from this brittle resin (resinified insoluble matter) as resin acids (10) (text fig. 3). They gave the following constants: Resin acids (10): saponification number, 156; acid number, 124.45; ester number, 31.55.

As shown by the ester number the resin acids (10) resembled the acids (5) (text figs. 2 and 3), as they consist of free resin acids and a lactone. In accordance with the procedure given in text fig. 2, the acids (10) were separated into resin acid (11) and resin acid (12). These acids gave the following constants: Resin acid (11): saponification number, 189.6; acid number, 168.22; ester number, 21.38. Resin acid (12): saponification number, 135.3; acid number, 73.35; ester number, 61.95.

The composition of the resin acids (10) was calculated in the same manner as that employed for resin acids (5). The following results were obtained.

Composition of acids (10):

38.12 per cent acid (11)
61.88 per cent acid (12)

100.00 per cent total

Review of resin acids.—A general outline indicating the separation of resin acids from Manila copal is given in text fig. 3. The constants of these various acids are also included for comparison.

The data we obtained show that various resin acids may be isolated from Manila copal. Resin acids (5) obtained directly from the copal may be separated into two other acids, resin acids (6) and (7).

FIG. 3. Separation of resin acids from Manila copal.

The resenes (4) also prepared directly from the copal may be converted into a brittle resin (8) from which resin acids (9) are obtained. These acids are very likely a mixture consisting of two resin acids.

The insoluble matter separated from the copal usually consists of a mixture of foreign matter and gelatinous copal. The latter can be changed into a brittle copal resin yielding acids (10). These acids were separated into resin acid (11) and resin acid (12).

A further investigation of the acids in Manila copal is contemplated.

SUMMARY

Manila copal is one of the principal minor forest products of the Philippines and the most important of the Philippine resins. It is used mostly in making high-grade varnishes.

A method was devised for the quantitative analysis of this resin and eleven samples from various provinces were analyzed.

The resin consists mostly of resin acids together with some terpenes, resenes, and insoluble matter (alcohol insoluble).

The insoluble matter in the samples analyzed ranged from 0.72 to 42.62 per cent. In general, the more insoluble matter there is in the copal the lower the grade.

The quality of copal from different localities varies greatly.

The resin acids in Manila copal consist of two kinds—a resin acid (6) with a high saponification number and a resin acid (7) with a low saponification value.

The resenes and the gelatinous material contained in Manila copal may be converted into resin acids similar to those obtained directly from the copal.

The melting point of the copal (Table 1) was determined by the mercury method of Durran as modified by Rangaswami.[24]

ACKNOWLEDGMENT

The authors wish to thank Miss Gloria Manalo and Mrs. Carmen L. Intengan for assistance in checking the analytical procedures.

[24] Oil Col. Chem. Ass. 13 (1930) 287.

ILLUSTRATIONS

PLATE 1.

1

2

PLATE 2.

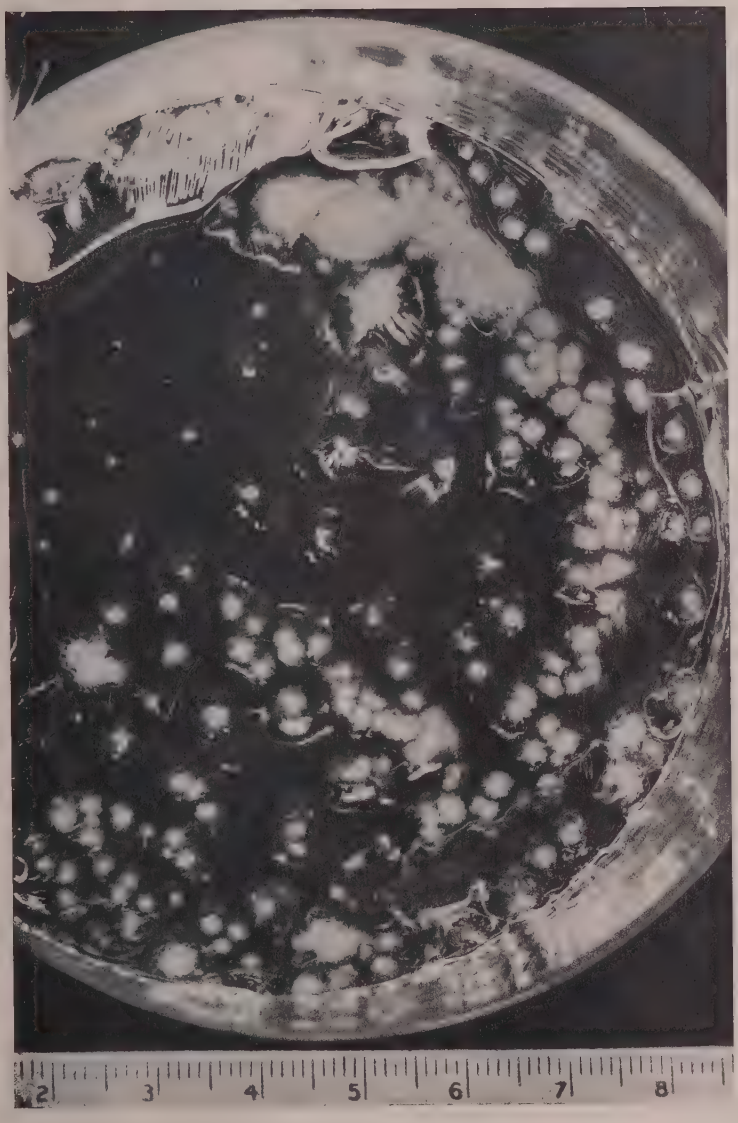


PLATE 3.

THE REFINING OF MANILA COPAL

By S. S. Tanchico and Augustus P. West

Of the Bureau of Science, Manila

ONE PLATE AND TWO TEXT FIGURES

The copal tree (*Agathis alba* Lam.) grows throughout the Philippines from the extreme north of Luzon to the southernmost islands of the group. When the bark of this tree is cut the resin, Manila copal, oozes out. The resin is used principally for making quality varnishes.

At present only high-grade Manila copal, to the amount of about 200,000 pesos,[1] is exported annually from the Philippines. By refining the low-grade resin so as to eliminate undesirable constituents the exportation should be greatly increased. We have devised a comparatively economical process for purifying copal, and the laboratory data are presented in this report.

In the preceding paper [2] we gave the results of our method for analyzing Manila copal. This product was found to consist mostly of resin acids together with some terpenes, resenes, and material insoluble in alcohol. The insoluble matter ranged from 0.72 to 42.62 per cent. It was generally composed of gelatinous resin together with foreign matter such as dirt, pieces of leaves, twigs, and the like. Copal containing such ingredients is considered low-grade and dealers in the Philippines do not care to handle it.

The local commercial process for improving the quality of crude copal consists in simply scraping or chipping the surface to remove foreign impurities. Although the scraped copal has a clean surface and appears to be high-grade, the interior may contain undesirable insoluble material. Again, the scrapings that are discarded usually include some good copal.

[1] One peso equals 50 cents United States currency.

[2] Tanchico, S. S., and A. P. West, Analysis and composition of Manila copal. This issue, page 259.

Our investigation has shown that a considerable amount of the insoluble matter in low-grade copal may, as a rule, be recovered as soluble brittle resin. This is accomplished by treating the crude copal with hot alcohol. The mixture is allowed to stand overnight to settle out the constituents that do not dissolve in alcohol, and then filtered. When the insoluble matter is heated to a temperature of 50 to 60° C., the gelatinous resin contained in it slowly undergoes various changes. It is first converted into a viscous, elastic material that gradually changes to an amorphous solid which finally becomes an impure brittle resin. We found that with some samples this transformation may be hastened by simply boiling the amorphous solid with water or steaming for about three hours, after which the brittle resin is drained and dried at 50 to 60° C.

The gelatinous part of the insoluble matter is thus turned to a brittle copal resin soluble in alcohol. It would appear that the gelatinous material is very closely related to the genuine copal and is probably a modified or oxidized form.

An outline showing a process for making refined copal from the crude and also from the insoluble matter in the crude is given in text fig. 1, which shows the relation between these various products and their constants.

The refined copal from filtrate A had a saponification number (213.03) larger than that (207.05) of the crude copal, because the latter contained dirt and other insoluble impurities that decreased the saponification number. Again, the saponification value (213.03) of the refined copal from filtrate A was greater than that (190.65) of the brittle copal obtained from the insoluble matter. The first refined product originated from the genuine resin in the crude copal while the second was derived from the gelatinous material in the crude copal.

This sample (No. 19) of crude copal contained 14 per cent of material that did not dissolve in alcohol. Ordinarily this kind of resin is not handled by local dealers as the insoluble matter consists largely of gelatinous copal. By refining the crude resin in accordance with the outline in text fig. 1 most of the gelatinous copal (about 12 per cent) was converted into brittle copal soluble in alcohol and recovered. Thus only about 2 per cent was discarded as foreign material.

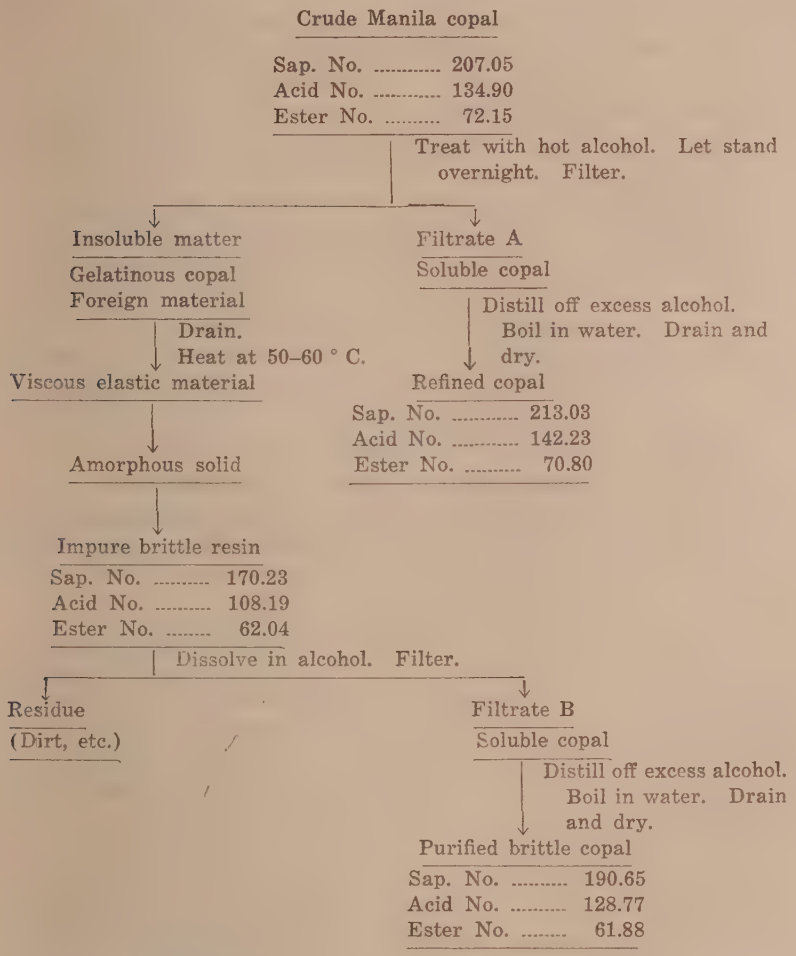


FIG. 1. Refined copal from crude copal (sample 19) and from the insoluble matter in crude copal.

The process for refining copal (text fig. 1) may be abbreviated by simply combining filtrate B with filtrate A and continuing with the procedure for filtrate A. In Table 1 are given the analysis and constants of a sample (No. 20) of crude copal and also the purified product made from it by this abbreviated method.

TABLE 1.—*Analysis of crude and refined copal.*

Constants and constituents.	Copal.	
	Crude.	Refined.
Constants:		
Saponification No.	202.50	212.63
Acid No.	134.37	137.87
Ester No.	68.13	74.76
Analysis:	*Per cent.*	*Per cent.*
Insoluble matter	10.03	
Terpenes	9.00	3.35
Resenes	2.64	2.20
Resin acids	76.65	81.30
Water (by difference)	1.68	13.15
Total	100.00	100.00

NOTE.—Crude copal was sample 20.

As shown by the results, the refined product contained no objectionable material insoluble in alcohol as this was removed in the refining process. However, all of this insoluble matter was not discarded, for about three quarters of it was converted into brittle resin and thus recovered.

The refined copal contained a much smaller amount of terpenes than the crude. In distilling filtrates A and B some of the terpenes were removed from the copal as they were volatile with alcohol. This tends to improve the quality of the refined product, for it is customary to "run" copal before using it in making oil varnish. The "running" consists in heating the copal to a temperature of about 310° C., until frothing ceases and the melt boils uniformly. In the running process most of the terpenes are volatilized.

The refined copal obtained by combining filtrate B with filtrate A (text fig. 1) and removing the alcohol contained a rather large amount of water (13.15 per cent, Table 1). Anhydrous brittle copal was produced by still further modifying the procedure as indicated in the following outline.

Filtrate B (text fig. 2) was combined with filtrate A and distilled until no more alcohol passed over into the distillate. Removal of the alcohol was facilitated by stirring the solution during distillation. The residue consisting of molten refined copal was then poured out quickly (while very hot) on a porcelain slab. The mass cooled to a brittle transparent resin. Lumps of this resin were broken open and the interior tested for moisture with

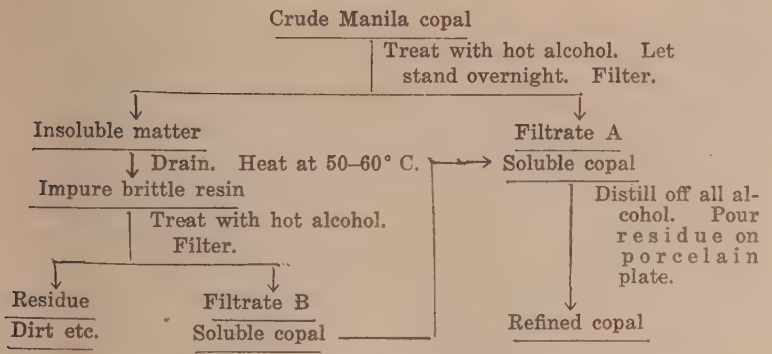


FIG. 2. Process for making refined copal that is transparent, brittle, and anhydrous.

anhydrous copper sulphate. The result was negative. This refined copal contained no insoluble matter as it was completely soluble in alcohol.

Plans are being prepared for the establishment of a pilot plant to convert low-grade copal into high-grade.

SUMMARY

At present only high-grade Manila copal, to the amount of about 200,000 pesos, is exported annually from the Philippines. Much of the copal that is available in these islands is not purchased by dealers because the resin contains considerable material that does not dissolve in alcohol. Some samples have over 40 per cent of this insoluble matter.

The only local means now employed for improving the quality of copal consists in simply cleaning the weathered and contaminated surface of the resin by scraping or chipping. Although the scraped copal appears to be high-grade, the interior may contain undesirable insoluble material not removed by this process. Moreover, some good copal is discarded with the waste.

An economical chemical procedure for refining low-grade copal has been devised and is reported in this paper. It consists essentially in first treating the crude resin with hot alcohol and removing the insoluble matter by filtering. Refined copal is recovered from the alcoholic solution. The insoluble matter usually contains a large amount of gelatinous resin. The efficiency of our refining process depends upon the fact that the

gelatinous resin is converted into refined copal and recovered. The only loss is the foreign material (dirt and the like) and a small amount of alcohol (about 5 per cent) that volatilizes during the process. With proper equipment the alcohol loss could very likely be reduced.

The refined product thus obtained is transparent, brittle, and anhydrous. It is also entirely soluble in alcohol and uniform in composition. That is, it consists only of the resin acids of copal together with some terpenes and resenes.

Plans are being prepared for the establishment of a pilot plant to convert low-grade copal into high-grade.

ILLUSTRATIONS

PLATE 1. TRANSPARENT, REFINED, COPAL.

NOTES ON FISHES IN THE ZOÖLOGICAL MUSEUM OF STANFORD UNIVERSITY, VIII

A NEW GENUS AND TWO NEW SPECIES OF CHINESE GOBIES WITH REMARKS ON SOME OTHER SPECIES

By Albert W. C. T. Herre

Of Stanford University, California

ONE PLATE

The gobies noted herein were mostly obtained during my sojourn in the Chusan Islands off the coast of China at the mouth of Hang Chow Bay and elsewhere in Chekiang Province, and at Hongkong. Most of my collecting was done around Tinghai, on Chusan Island. Specimens were also secured at Pu Taw Island, East Saddle Island, and on the mainland near Ningpo. Mr. B. E. Sugars, of Hongkong, also collected specimens.

It is believed that most of the marine gobies found along the central and southern coasts of China will ultimately be secured in the Philippines, particularly among the Batanes and Babuyanes Islands, and along the coasts of northern Luzon.

ELEOTRIDÆ

Genus SINELEOTRIS novum

Dorsals IX (or VIII?), I, 11 or 12; anal I, 8; scales ctenoid, about 36 in longitudinal series, extending before dorsal to eyes; sides of head completely scaled, interorbital and snout naked; no preopercular spine. Isthmus broad, gill slit extending beneath middle of eye. Jaws even, teeth small, of uniform size, in several rows, without canines. No teeth on palate and no bony crests on top of head.

From *Micropercops* and other genera *Sineleotris* differs in the strongly marked scalation of the head, in the shape of head, mouth, and teeth, and in other respects. Type species, *Sineleotris saccharæ* sp. nov.

SINELEOTRIS SACCHARÆ sp. nov.

Dorsals IX, I, 12; anal I, 8. Eleven scales in transverse series, 36; in longitudinal series, 2 or 3 very small scales on caudal base;

predorsal scales 12; 4 rows of scales on preopercle, 5 on opercle. All scales ctenoid except 2 or 3 rows between dorsal origin and eyes.

Head and body laterally compressed, upper profile convex from dorsal origin to tip of snout, caudal peduncle long and slender. Snout blunt, nape thick and rounded. Depth 4.4, head 3.25, caudal 4.25, pectoral 3.9, ventral 4.58 times in length. Eye large, lateral, projecting above profile, 3.8 times in head, snout broadly rounded, 3.4 times in head. Interorbital a trifle more than an eye diameter in breadth. Mouth small, maxillary barely reaching below front rim of eye and equal to snout. First dorsal not elevated, all spines with filiform tips, longest spine 2.12 in head or 6.875 times in length, barely reaching second dorsal origin when depressed. Second dorsal a little higher, 6.1 times in length, separated from caudal by 3 scales when depressed; anal height equal to that of first dorsal and further forward than second dorsal, tip separated from caudal by 6 scales when depressed. Pectoral and ventral both narrow and elongated, slender tip of ventral reaching anal origin. Least depth of caudal peduncle 2.35 times in own length. Anal papilla of male long, thin, flattened.

Ground color in alcohol pale tan, obscured on upper half by dark-brown blotches and spots over back and along middle of side, intervening scales more or less darkened so that there are several longitudinal rows of dark-brown spots, one on each scale, along middle of side. In life these spots were 4 broad, violet, dorsal crossbands and 5 similar median blotches along the side. On caudal base a darker vertical bar. From eye a violet-brown bar running downward across cheek to under side of head. Two violet-brown lines extending from eye on snout to maxillary; behind eye 2 or 3 longitudinal violet-brown lines running to posterior end of head and another below eye across preopercle and opercle to upper end of pectoral base. On first dorsal a large violet-black spot between first and fifth spines, on middle and upper part; lower part pale or whitish, rest of fin pale violet-brown. Basal third of second dorsal white-spotted, rest of fin violet-brown; anal pale violaceous brown; caudal rays alternately crossbarred with spots of white and brown.

The type and only specimen is a male, 55 mm long. It was collected by Mr. B. E. Sugars, secretary of the Hongkong Aquarium Society, in the New Territory, Hongkong.

BOSTRICHTHYS SINENSIS (Lacépède).

Five specimens, 91 to 134 mm long, from Tinghai. Easily recognized by the large ocellus at the caudal base, and the patch of vomerine teeth.

ODONTOBUTIS DAVIDI (Sauvage and Thiersant).

Seven specimens from a stream near Yu Hwang Temple, Chinhai District, Chekiang Province, 49 to 108 mm long. There are 38 scales in a longitudinal and 13 in a transverse series; predorsal scales 20.

ODONTOBUTIS OBSCURUS (Schlegel).

Five specimens from the Yung River, Ningpo, 112 to 124 mm long, and 2 from Tinghai, 88 and 140 mm long.

Dorsals VI, I, 8 or 9; anal I, 7; scales 34 or 35; predorsal 26.

CTENOGOBIUS CHUSANENSIS sp. nov. Plate 1.

Dorsals VI, I, 10; anal I, 9; scales in longitudinal series 40, plus 3 or 4 on caudal base; transverse series 12; predorsal scales none.

Depth 6.1 to 6.4, head 4, pointed caudal 2.6 to 3, pectoral 4 times in length. Eye 4.4 to 4.6, snout 3.1 to 3.3 times in head.

Body slender, elongate, little compressed, dorsal and ventral profiles horizontal and parallel to caudal peduncle, snout bluntly rounded. Width of head a little more than depth and 1.5 times in its length. Eyes very high up, laterodorsal, protuberant, interorbital very narrow and contained more than 5 times in eye. Convex snout somewhat protuberant, lips even, tongue truncate. Teeth in two rows in each jaw, outer row much larger than inner and terminating in a small posterior canine in lower jaw. Maxillary reaching a vertical from anterior edge of pupil. Full cheek with 3 horizontal rows of papillæ, lowest from angle of mouth; opercle with one long vertical row of papillæ and 3 short horizontal rows; head and nape naked. First dorsal with second spine very long and threadlike, 2.8 to 3.3 in length, third spine sometimes nearly as long; dorsals very close together, penultimate ray of high second dorsal extending on caudal base, 4.8 to 5.5 times in length; anal falling short of caudal when depressed, its penultimate ray 4.8 to 6 times in length. Pectoral broad, sometimes pointed; ventral falling far short of anus, 5.3 times in length.

In alcohol pale yellowish white, scales along back faintly edged with black along hind margin; on last half of trunk a faint, dark, longitudinal band along middle of side; anal and ventrals

more or less dusky, second dorsal somewhat darkened; other fins clear, caudal with a row of small dark dots near its upper margin.

In life this little goby is one of extraordinary beauty, with elongate pearly blue marks along the sides; the second dorsal, caudal, ventrals, and anal are violet blue, the anal darkest; there is a row of dark spots along the upper part of the caudal; the eyes are more or less blue to greenish. The species presents a remarkable contrast to the filthy mudholes in which it lives.

The type, 67 mm long, and two smaller paratypes, down to 44 mm long, were taken from a puddle in a mudbank exposed at low tide, on an islet across the tidal stream from Tinghai, Chusan Island, China.

ACANTHOGOBIUS OMMATURUS (Richardson).

Thirty-six specimens, from 26 to 160 mm long, were obtained from tidal mud puddles, Chusan Island. Dorsals VIII or IX, I, 16 to 18; anal I, 14 or 15; scales 68 to 72. In life the prominent eyes are bright blue-green or zircon green.

AMBLYCHÆTURICHTHYS HEXANEMA Bleeker.

Three specimens, 69 to 86 mm long, were collected at Tinghai. Dorsals VIII, I, 15 or 16; anal I, 12 or 13; scales 38 to 40. Under lower jaw 3 pairs of small barbels. No fleshy papillæ on inner edge of shoulder girdle.

CHÆTURICHTHYS STIGMATIUS Richardson.

One specimen, 81 mm long, from Tinghai. Dorsals VII, I, 22; anal I, 18; scales about 48 to 50. Recognized by the elongate dorsal and anal, 3 fleshy papillæ on inner edge of shoulder girdle, and 3 pairs of short barbels under lower jaw.

CHASMICHTHYS PETSCHILIENSIS (Rendahl).

Twenty-one specimens, 27 to 42 mm in length, from East Saddle Island. Previously known only from 6 specimens taken in Chihli Province.

CTENOGOBIUS LINI Herre.

A specimen 71 mm long was secured at Hongkong. Hitherto known only from Wuchow, Kwangsi Province.

SYNECHOGOBIUS HASTA (Schlegel).

Two specimens, 120 and 162 mm long, from tide pools at Tinghai. Dorsals IX, I, 18; anal I, 15; scales about 88. Body very elongate, with a noticeably elongate and strongly compressed caudal peduncle.

TRIDENTIGER BIFASCIATUS Steindachner.

Forty-seven specimens from Tinghai, where this species is abundant in the muddy pools along the shore; 4 from Pu Taw Island, and 4 from the Tsien Tang Kiang, 17 to 49 mm long.

This species is recognized by the 2 conspicuous black longitudinal bands from the eye to the caudal base. It is very close to *Tridentiger trigonocephalus*, and needs careful study to determine whether it is really specifically distinct or is only a variety of the latter.

TRIDENTIGER TRIGONOCEPHALUS (Gill).

Dorsals VI, I, 12 or 13; anal I, 10 or 11; scales in longitudinal series about 60, transverse series 22; predorsal 26 to 28.

Preserved specimens have a pale yellow ground color, with 8 dusky or brown crossbands, posterior crossbands forked in their lower half, first band above pectoral base, last at caudal base; sometimes crossbands connected along middle, in which case the specimens have a median longitudinal stripe. Body covered with minute dark specks, giving it usually a gray color; top and sides of head mottled with brown or dusky streaks; a short longitudinal dark bar behind eye; both dorsals with a basal yellow band or row of yellow spots, with alternate brown or dusky and yellow bars or spots above, upper half usually all brown; anal with a broad dusky band across its outer portion; caudal dusky, barred with yellow or white spots and with a black spot at upper end of its base; pectoral dusky with a broad yellow bar across base of its rays.

Common among rocks on the cost of Pu Taw Island, Chusan Archipelago, where 82 specimens, 17 to 65 mm long, were obtained.

Statistical study of a sufficiently large series might relegate *T. bifasciatus* to the synonymy of this species, or reduce it to the rank of a subspecies.

PERIOPHTHALMIDÆ

PERIOPHTHALMUS BARBARUS (Linn.)

Fourteen specimens, 12 to 68 mm long, from Tinghai.

GOBIOIDIDÆ

NUDAGOBIOIDES NANKAII Shaw.

Five specimens, 79 to 116 mm long, from the market at Tai Po, New Territory, Hongkong. Hitherto known from a single specimen at Nankai University, Tientsin.

ODONTAMBLYOPUS RUBICUNDUS (Buch.-Ham.)

Five specimens, 71 to 250 mm long, were taken at Tinghai.

TRYPAUCHENIDÆ

TRYPAUCHEN VAGINA Bloch and Schneider.

Four specimens from Tinghai are from 83 to 120 mm long. They are identical with *Trypauchen wakæ* Jordan and Snyder, from Japan. After comparing the original specimens of *T. wakæ* with numerous specimens of *T. vagina* from many localities in the Oriental Tropics, I cannot separate the two. *T. wakæ* falls within the ordinary variation occurring in any lot of *T. vagina*, and therefore is reduced to synonymy. *T. wakæ* is not a valid species.

ILLUSTRATION

PLATE 1. *Ctenogobius Chusanensis* sp. nov.

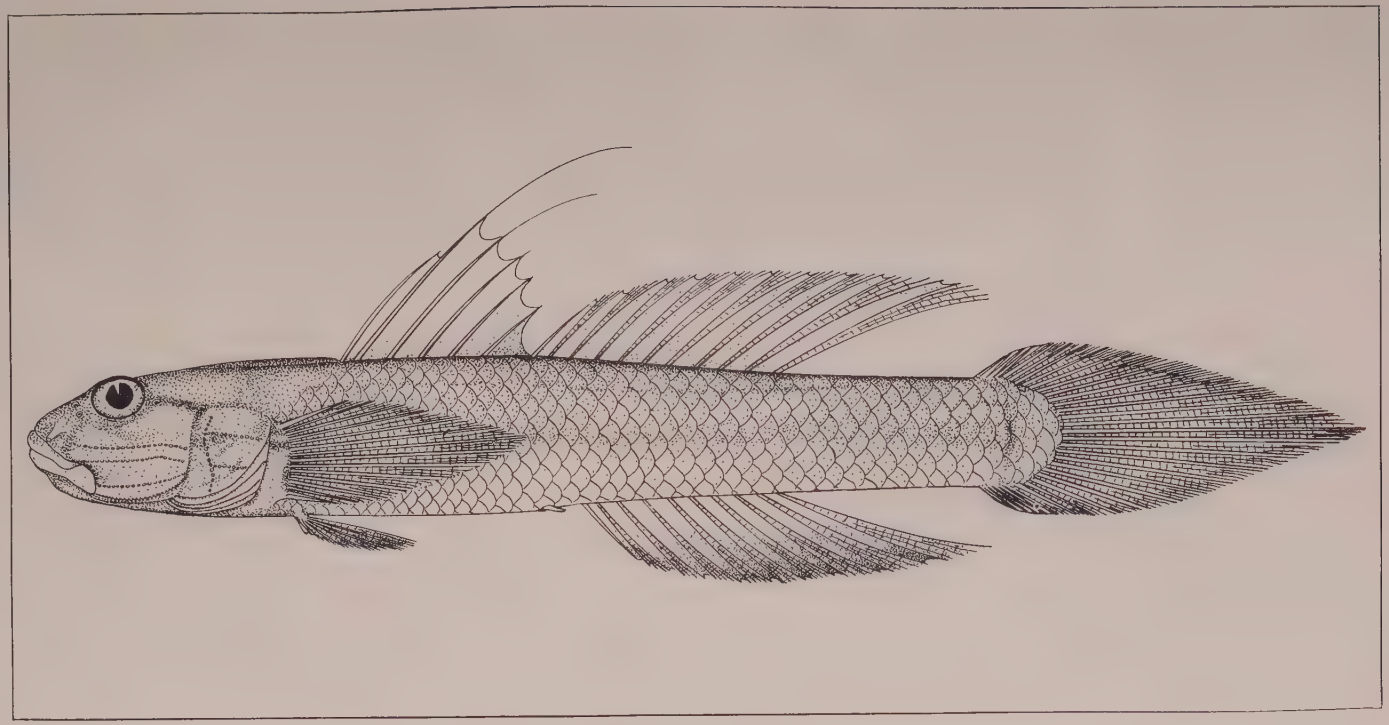


PLATE 1. CTENOGOBIUS CHUSANENSIS SP. NOV.

NEW PHILIPPINE GOBIOID FISHES [1]

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and

Guillermo L. Ablan

Of the Division of Fisheries, Department of Agriculture and Commerce Manila

EIGHT PLATES

In this paper are described 8 apparently new species of gobioid fishes, collected from Lingayen Gulf, which borders Pangasinan and La Union Provinces. Three species belong to the genera *Hypseleotris, Boroda,* and *Paloa* of the family Eleotridæ, while 5 belong to the genera *Bathygobius, Mugilogobius, Tamanka,* and *Nudagobioides* of the family Gobiidæ. The types and cotypes are in the ichthyological collection of the Division of Fisheries, Department of Agriculture and Commerce, Manila.

Genus HYPSELEOTRIS Gill, 1863

Hypseleotris Gill, Proc. Acad. Nat. Sci. Phila. 15 (1863) 270.

Dorsals VI, I, 8 to 11; anal I, 9 to 11. Body oblong, rather short, very much compressed, pointed, higher than wide, sides scaled, without bony crests above; mouth oblique, with short jaws, lower jaw prominent; the slender awl-shaped teeth in several rows in each jaw, subequal, without canines; scales large, 23 to 32 in lateral series; dorsals well separated, rather low; caudal obtuse. Anal papilla more or less oblong or square, with notched or square, bilobed tip, often very large, and in some species with revolute edges.

HYPSELEOTRIS QUISUMBINGI sp. nov. Plate 1.

Dorsals VI, I, 8 or 9; anal I, 10; 26 to 29 scales in longitudinal series, 8 or 9 in transverse series, 17 to 19 before first dorsal.

Dorsal contour of body slightly arched, abdomen almost straight, snout rounded, mouth very small and almost vertical with a prominent lower jaw; angle of maxillary very far from eye; body covered with large scales except lips, chin, and anterior portion of snout. Eye twice snout; interorbital 2.5 times in

[1] This paper was submitted for publication when the senior author was connected with the Division of Fisheries.

head; subtruncate caudal 3.7 times in length, equal head. Greatest depth of body equal to or slightly greater than caudal or head, thickness about twice depth. Genital lobule (anal papilla) large, flat, notched. Ventral rays slightly longer than pectoral rays. Base of pectoral about 1.75 times caudal; base of first dorsal a little less than base of second dorsal which equals anal.

The specimens after a few days in preserving spirit have the following colors: Body grayish, shaded with minute, dark chromatophores particularly on dorsal side; on base of pectoral chromatophores become larger and closely set, forming a prominent bar; behind this bar a fine, dark streak at point of origin of pectoral rays; another fine, blackish streak very evident from upper margin of pectoral base along lateral side to caudal. Spinous dorsal basally pale and crossbarred alternately with pale and dark in greater part of fin similar to second dorsal. Anal and caudal more or less shaded by transverse rows of pale and dark specks. Along ventral side on abdomen from origin of anal to caudal a blackish streak more prominent than the lateral streak always present.

This species resembles *H. pangel* Herre in the number of fin rays on the dorsals and anal and also in the number of scales in the transverse and lateral series. It differs, however, in having more predorsal scales, in having a subtruncate caudal, and in the presence of a more prominent ventral streak.

Described from the type, No. 31952, 56 millimeters in standard length, and four cotypes, from 41 to 51 millimeters long, collected by the junior writer from San Fernando Market, La Union Province, March 9, 1939.

Quisumbingi in honor of Dr. Eduardo Quisumbing, curator of the National Museum.

Measurements of type specimen No. 31952: total length, 69.5 mm; standard length, 55; head length, 14; head breadth, 12; head depth, 10; snout, 3; eye, 4; interorbital, 4; body depth, 10; body breadth, 13; snout tip to first dorsal, 24; base length of first dorsal, 6; base length of second dorsal, 8; length of caudal, 14; depth of caudal base, 6; length of pectoral, 13.5; length of ventral, 12.5; base length of anal, 9.

Genus BORODA Herre, 1927

Boroda HERRE, Gobies of the Philippines and China Sea. Bur. Sci. Monog. 23 (1927) 59.

Dorsals VI, I, 9; anal I, 8 or 9. Body wedge-shaped and compressed, with very large, wide, depressed head, and strongly

projecting lower jaw; four rows of teeth anteriorly in both jaws, outer and inner rows enlarged and more or less caniniform; scales usually all cycloid, those on sides of body sometimes ctenoid; from 50 to 60 scales in longitudinal series and from 17 to 20 in transverse series; head entirely scaled, with from 32 to 42 scales before first dorsal; pores on head conspicuous; caudal broad, rounded, much shorter than head, its basal portion scaled.

BORODA FRANCOI sp. nov. Plate 2.

Dorsals VI, I, 8; anal I, 9; scales in longitudinal series about 52, before first dorsal 36 to 40, in transverse series 14. Head broad, low, dorsal profile gradually descending to tip of snout; 2.9 to 3.1 in length, its greatest breadth greater than depth of body and equal to caudal; eyes prominently large, 4.3 to 4.5 in head, slightly greater than snout and about that much less in interorbital space; mouth wide, its width equal to a fourth or fifth of first dorsal spine, oblique; posterior angle of maxillary below middle of eye; lower jaw longer than upper jaw, projecting; four rows of teeth anteriorly in both jaws, outer and inner rows enlarged and more or less caninoid; preorbital pores present. Body wedge-shaped, elevated before first dorsal, 2.5 in length; caudal peduncle broad, laterally compressed, 1.7 to 2.1 in its length. Spinous dorsal with a base equal to first spine and with longest rays less than those of the second spine; base of second dorsal greater than anal but with longest rays equal; caudal elongate and pointed; pectoral long and pointed, its length equal to space between anal and ventral; ventral with long rays extending to below last ray of spinous dorsal.

Color in life not much changed in preservative, blackish; all fins concolorous with body, except anal which is sometimes black, but which usually harmonizes with the grayish portion of the ventral side.

This species resembles *B. albo-oculata* Herre and *B. expatria* Herre in spinous dorsal fin-ray count only. It differs from them in having fewer rays in the second dorsal and fewer scales in the transverse series, in having a broad but pointed caudal, and in the presence of preorbital pores.

Described from type specimen No. 31947 and cotype collected by hook-and-line in Dagupan River, Pangasinan Province, Luzon.

Francoi, for Mr. Felix Franco, formerly Assistant Chief, Fish and Game Administration, Bureau of Science, Manila, for his devotion to Philippine fisheries.

Measurements of type specimen No. 31947: total length, 80 mm; standard length, 63; head length, 21.5; head breadth, 17; head depth, 14; snout, 4; eye, 5; interorbital, 6; body depth, 16; body breadth, 14; snout tip to first dorsal, 28; base length of first dorsal, 7; base length of second dorsal, 11; length of caudal, 17; depth of caudal base, 8.5; length of pectoral, 17.5; length of ventral, 12.5; base length of anal, 9.

Genus PALOA Herre, 1927

Paloa HERRE, A. W. Gobies of the Philippines and China Sea. Bur. Sci. Monog. 23 (1927) 56.

Dorsals V or VI, I, 10; anal I, 8; scales in longitudinal series 92 or more; before first dorsal about 62; teeth six rows in upper jaw, those of outer row enlarged, stout, conical; remaining teeth minute except for four central teeth of innermost row, which are enlarged and strongly curved backward; in lower jaw an outer row of few, widely spaced, enlarged, conical teeth, followed by three rows of minute teeth. Body robust, little elevated, compressed, with a large, wide, depressed head, full cheeks, oblique mouth, and projecting chin; eyes small, dorsolateral; interorbital space wide; vertical fins all low; dorsals far apart, height of first dorsal less than half depth of trunk; pectorals and ventrals narrow and short; caudal broad, rounded, much shorter than head; entire body, except lips, tips of snout, and ventral surface of head, covered with small cycloid scales, which extend upon pectoral and caudal fins; numerous lines of very minute papillæ radiating from eyes and running longitudinally and vertically on cheeks.

PALOA VILLADOLIDI sp. nov. Plate 30.

Dorsals VI, I, 9; anal I, 8; scales in longitudinal series about 100; before first dorsal 62; 36 in transverse series. Head prominently large, broad, deeper than body; dorsal profile slightly flattened, more than 3.7 in length; breadth equal to length; snout wide and blunt at tip; its length 3.75 in head; eyes small, dorsolateral in position, 7.5 in head, 2 in snout, 3 in semidepressed interorbital which is 2.5 times in head; mouth strongly oblique or nearly vertical, angle of maxillary much in advance of eye; lower jaw slightly projecting, with a very prominent chin; cheeks full and rounded; minute papillæ radiating from eye, above and below it, and on preopercle; rod-shaped papillæ present on chin under lower jaw. Body subcylindrical anteriorly, tapering posteriorly from second dorsal to a little behind

level of anal from where it becomes elevated to caudal; depth a tenth greater than its breadth. First dorsal low, its base twice that of second; second dorsal greater than anal; pectorals short, broad and pointed, shorter than rounded caudal; ventrals small, narrow, 1.4 times head.

In life pectoral, ventrals, and anal grayish, caudal and second dorsal orange-yellow, head and body light Italian ochre, ventral side grayish. Two colored longitudinal bands on the side becoming more distinct after a few hours of preservation.

This species is very close to *P. polylepis* Herre in dentition, in the number of rays in the first dorsal and anal, and in the number of scales before dorsal and in transverse series. It differs from it in having more scales in the longitudinal series and fewer rays in the second dorsal, and in the presence of rod-shaped papillæ on the chin below the lower jaw.

Described from the type, No. 31946, collected by the junior author in Dagupan, Pangasinan Province, Luzon.

Villadolidi, in honor of Dr. Deogracias V. Villadolid, for his interest in Philippine ichthyology.

Measurements: total length, 69.5 mm; standard length, 56; head length, 15; head breadth, 15; head depth, 12; snout, 4; eye, 2; interorbital, 6; body depth, 11; body breadth, 10; base length of first dorsal, 6; base length of second dorsal, 12; length of caudal, 13.5; depth of caudal base, 8.5; length of pectoral, 9.5; length of ventral, 10; base length of anal, 10.

Genus BATHYGOBIUS Bleeker, 1878

Bathygobius Bleeker, Arch. Neerl. Sci. Nat. 13 (1878) 58.
Mapo Smitt, Ofv. Vet. Ak. Forh. (1899) 543.
Vaimosa Jordan and Seale, Bull. Bur. Fish. 25 (1906) 395.

Dorsals VI, I, 8 to 11; anal I, 7 to 9. Body with 35 to 43 scales in longitudinal series. Neck covered with moderate scales, longitudinal median groove more or less developed. Breast scaled. Head depressed, scaled above after the eyes (in *B. cocosensis* naked). Preoperculum and operculum scaled or naked. Snout about as long as diameter of eye. Mouth a little oblique, lower jaw a little prominent. In both jaws, outer row of teeth enlarged, in lower jaw outer row of teeth extending to half of jaw; laterally inner row enlarged, sometimes caniniform. A mucous canal from snout to angle of mouth, where it divides into two canals running over preoperculum; one canal runs along lower jaw to posterior margin of preoperculum. Gill openings not very wide, about as long as base of pectoral fin;

isthmus broad. Pectorals with some free silklike rays at upper margin.

BATHYGOBIUS LAŒ sp. nov. Plate 4.

Dorsals VI, I, 9; anal I, 7; scales 38 in longitudinal series, 19 before first dorsal and 10 in transverse series. Head broader than body by four tenths of depth, plume-shaped, cheeks bulging; eyes large, dorsolateral in position, with a diameter equal to snout; mouth low and slightly oblique and with a width equal to caudal; posterior angle of maxillary extending below middle of eye; a fourth of nape behind eyes naked; marking on head concolorous with body. Anterior part of body semicylindrical and slightly compressed and tapering from origin of second dorsal to anal; five dusky blotches saddling dorsals from nape to end of second dorsal. First dorsal low; second dorsal and anal not reaching caudal; pectorals with rays extending far back below second ray of second dorsal and a little greater than depth of head; caudal long and rounded, a little less than base of anal.

This species is very close to *Bathygobius bravoi* Herre in the number of second dorsal and anal rays. It differs in having more predorsal scales and less scales in transverse series.

Described from specimen No. 31948, a female with eggs collected by Miss Rosalina La-O of Dagupan, Pangasinan Province.

Laœ in honor of the collector.

Measurements: total length, 55 mm; standard length, 46; head length, 16; head breadth, 14; snout, 4; eye, 4; body depth, 12.5; body breadth, 10; snout tip to first dorsal, 20; length of caudal, 9; depth of caudal base, 6; pectoral, 14.5; length of ventral, 27.

BATHYGOBIUS BLANCOI sp. nov. Plate 5.

Dorsals VI, I, 9; anal I, 8; scales 36 in longitudinal series, 12 in transverse series, 16 before first dorsal. Head slightly convex, laterally compressed and wedge-shaped when viewed from above, 2.84 times in length; snout short, convex, gradually descending, 4.3 in head; eyes large, conspicuous, greater than snout and twice in width of mouth; interorbital narrow, about 3 times eye; mouth large and oblique, upper jaw slightly protractile; posterior margin or angle of maxillary below middle of eye. Body wedge-shaped, compressed posteriorly, depth a little less than breadth of head. First dorsal lower than second dorsal and anal; pectoral elongate, with long rays extending as far as or beyond origin of second dorsal, length equally

distant from origins of anal and caudal, base slightly greater than depth of caudal; ventrals equal to width of head or caudal length; caudal depth 2 in body depth.

This species resembles B. *mearnsi* (Evermann and Seale) in the number of rays of the dorsals and anal but is very distinct from it in having a greater number of scales in the transverse series, and of predorsal scales.

Described from the type, No. 31949, collected in Dagupan, Pangasinan Province. *Blancoi* after Mr. Guillermo J. Blanco, a student of Philippine Crustacea.

Measurements: standard length, 37 mm; head length, 13; head breadth, 10; snout, 3; eye, 3.5; body depth, 9; base length of first dorsal, 9; depth of caudal base, 4.5; length of pectoral, 11; length of ventral, 10; base length of anal, 7.5.

Genus MUGILOGOBIUS Smitt, 1899

Mugilogobius SMITT, Ofv. Kon. Ak. Forh. (1899) 552.

Dorsals VI, I, 8; anal I, 8. Body elongate, cylindrical anteriorly, compressed posteriorly, with more or less 36 ctenoid scales in longitudinal series, growing larger posteriorly. Head scaled only above after eyes and on upper parts of opercles. Eyes on anterior half of head; interorbital space one-half diameter of eye. Anterior nostril in a short tube. Mouth oblique, jaws equal. Teeth in narrow bands in both jaws, outer teeth enlarged. Tongue slightly emarginate. No barbels on head. Gill openings restricted to sides, isthmus broad. Inner edge of shoulder girdle without fleshy flaps. Dorsal fins separate. Ventrals united. Pectorals without free silklike rays. Caudal rounded.

MUGILOGOBIUS LUZONENSIS sp. nov. Plate 6.

Dorsals VI, I, 7; anal I, 7. Scales 28 in longitudinal series, 8 or 9 in transverse series, and 13 to 16 before first dorsal. Head broader than deep, breadth 1.38 in length; snout short, convex, bluntly rounded, 4.5 times in head; eyes lateral, highly situated, 2 times interorbital; mouth oblique, terminal; jaws equal; posterior angle of maxillary extending to a point below middle of eye. Operculum with large scales. Body compressed, back slightly arched at first dorsal, ventral contour almost straight, depth 5 in length. First dorsal fin with rays reaching beyond base of second ray of second dorsal and with a blackish blotch; second dorsal with base slightly greater than anal; pec-

torals broadly pointed, 1.57 in head; caudal shorter than head, rounded, with 3 blackish small spots on center of base.

This species is very close to *M. dispar* Peters in the number of dorsal and anal fin rays and in the number of scales in the longitudinal and transverse series, but differs from the latter in having more scales before first dorsal.

Luzonensis, from Luzon Island, Philippines.

Measurements on type No. 31950: total length, 35 mm; standard length, 28; head length, 9; head breadth, 6.5; head depth, 5; eye, 2; interorbital, 4; body depth, 5.5; base length of second dorsal, 5; length of caudal, 4; depth of caudal base, 5; length of pectoral, 5.7; base length of anal, 4.5.

Genus TAMANKA Herre, 1927

Tamanka HERRE, Gobies of the Philippines and China Sea. Bur. Sci. Monog. 23 (1927) 220.

Dorsals VI, I, 7 or 8; anal I, 7 to 8. Body elongate, compressed, with 38 to 54 ctenoid scales in longitudinal series; nape scaled. Head scaled above after eyes or nearly naked; operculum covered with small cycloid scales. Eyes on anterior half of head, interorbital space broader than eye, snout longer than eye. Mouth oblique. Teeth in upper jaw in a band and a separate outer row of coarser teeth, none enlarged. Gill openings wide, isthmus broad. Inner edge of shoulder girdle without fleshy flaps. Dorsal fins separate. Pectoral without free silk-like rays. Caudal rounded.

TAMANKA ARGUELLESI sp. nov. Plate 7.

Dorsals VI, I, 8; anal I, 8; about 54 scales in longitudinal series, 12 in transverse series, 24 before first dorsal. Dorsal profile straight. Head 3.3 in standard length, with bulging cheeks, width less than depth. Preopercles convex, snout short, blunt, directed downward, equal to eye, interorbital space 2 times in depth of head, maxillaries almost equal, upper slightly protractile; chin strongly oblique, angle of maxillary extending almost to middle of eye. Fleshy upper lip with a pair of terminal pores. Body semicylindrical anteriorly, 1.4 in standard length, depth equal to head, 4 in length. Vertical depth from dorsal to anal equal to depth of head, 5 in length; caudal base slightly less than eye. First dorsal fin low, fifth ray when depressed reaching spine of second dorsal, greater portion with a distinct blackish blotch with a pale-yellowish outline. Second dorsal much higher than first, reaching caudal; every ray

blackish with outline of a yellowish band. Caudal rounded in young specimens, long and truncate in older ones, its greatest depth more than depth of body. Anal never reaching caudal when depressed. Pectorals broad and rounded, extending far back beyond base of first dorsal. Ventrals broad and elongate.

In life anal orange-yellow with a dusky outline; caudal cross-barred with black and yellow bands; back of body and head with rod-shaped bars. On cheek from each eye two prominent diagonal bars. On upper margin of snout, very far advanced from each eye, a prominent tubular pore.

This species is close to *T. umbra* Herre in the number of fin rays, but differs from it in having a greater number of scales in the longitudinal series, in the presence of bars on the dorsal side and cheeks, and also in the presence of a tubular pore in advance of each eye.

Described from the type, No. 31951, and 13 cotypes from Dagupan, Pangasinan Province, and San Fernando Market, La Union Province.

Arguellesi in honor of Angel S. Arguelles, Director of the Bureau of Science.

Measurements: total length, 59 mm; standard length, 47; head length, 13; head breadth, 10; head depth, 8; snout, 6; eye, 2.5; interorbital, 7; body depth, 9.5; body breadth, 6; snout tip to first dorsal, 18; base length of first dorsal, 5; base length of second dorsal, 9; length of caudal, 11.5; depth of caudal base, 6; length of pectoral, 11; length of ventral, 7; base length of anal, 6.5.

Genus NUDAGOBIOIDES Tsen-Hwang-Show, 1929

Nudagobioides SHAW, Bull. Fan Mem. Inst. Biol. (1) 1 (1929)

Dorsal VI, 45; anal I, 42. Body much elongate, compressed, naked or covered with rudimentary scales. Head naked; eyes minute; mouth oblique, lower jaw prominent. In each jaw a row of caninoid teeth; rudimentary teeth behind symphysis of lower jaw. Gill openings narrow. Dorsal fins continuous; both fins connected with caudal fin. Ventral shorter than pectoral, completely united. Pectoral rounded. Caudal pointed, longer than head. About 30 myotomes visible along sides of body.

NUDAGOBIOIDES MONSERRATI sp. nov. Plate 8.

Dorsal VI, 32; anal I, 31. Head 5.2 in body length; depth of head in body 7. Snout 4 in head; interorbital 4; width of head 1.33 of its length or equal to its depth. Body elongate, laterally

compressed, tapering posteriorly. Head and body naked, except precaudal region with small and circular rudimentary scales. Myotomes very distinct on body, 25 to 27 in number. Mouth oblique, lower jaw slightly projecting beyond upper jaw. Eyes very small, dorsally located. Interorbital equal to snout, width of tail, or space between base of pectoral to gill opening. Cheeks slightly swollen. A row of caninoid teeth in upper jaw and in lower jaw, rudimentary teeth behind symphysis of lower jaw. Gill opening extending upward to upper edge of pectoral base. Caudal pointed. Ventrals united, elongate, pointed or rounded, almost equal to width of head. Pectoral short, broad and round, with rays equal to width of mouth. Dorsal and anal continuous with caudal. Base of anal about 0.53 less than dorsal. Anal papillæ in one specimen elongate, knob-shaped in others. Yellowish in life, becoming grayish in alcohol.

This species is very distinct from *N. nankaii* Shaw in having fewer rays both in dorsal and anal, and in the presence of small, minute, rudimentary scales before caudal and fewer myotomes.

Described from the type, No. 31953, and three other specimens.

Monserrati in honor of Rafael Monserrat, a fish enthusiast of Pangasinan Province, Luzon.

Measurements of type, No. 31953; total length, 56.5 mm; standard length, 53; head length, 8; head breadth, 6; head depth, 6; snout, 2; interorbital, 2; body depth, 5; snout tip to first dorsal, 14; base length of first dorsal, 5; length of caudal, 3.5; depth of caudal base, 49; length of pectoral, 3; base length of anal, 32.

ILLUSTRATIONS

[Drawn by Pio C. Medel. Scale equal to 1 cm.]

PLATE 1. *Hypscleotris quisumbingi* sp. nov.
2. *Boroda francoi* sp. nov.
3. *Paloa villadolidi* sp. nov.
4. *Bathygobius loœ* sp. nov.
5. *Bathygobius blancoi* sp. nov.
6. *Mugilogobius luzonensis* sp. nov.
7. *Tamanka arguellesi* sp. nov.
8. *Nudagobioides monserrati* sp. nov.

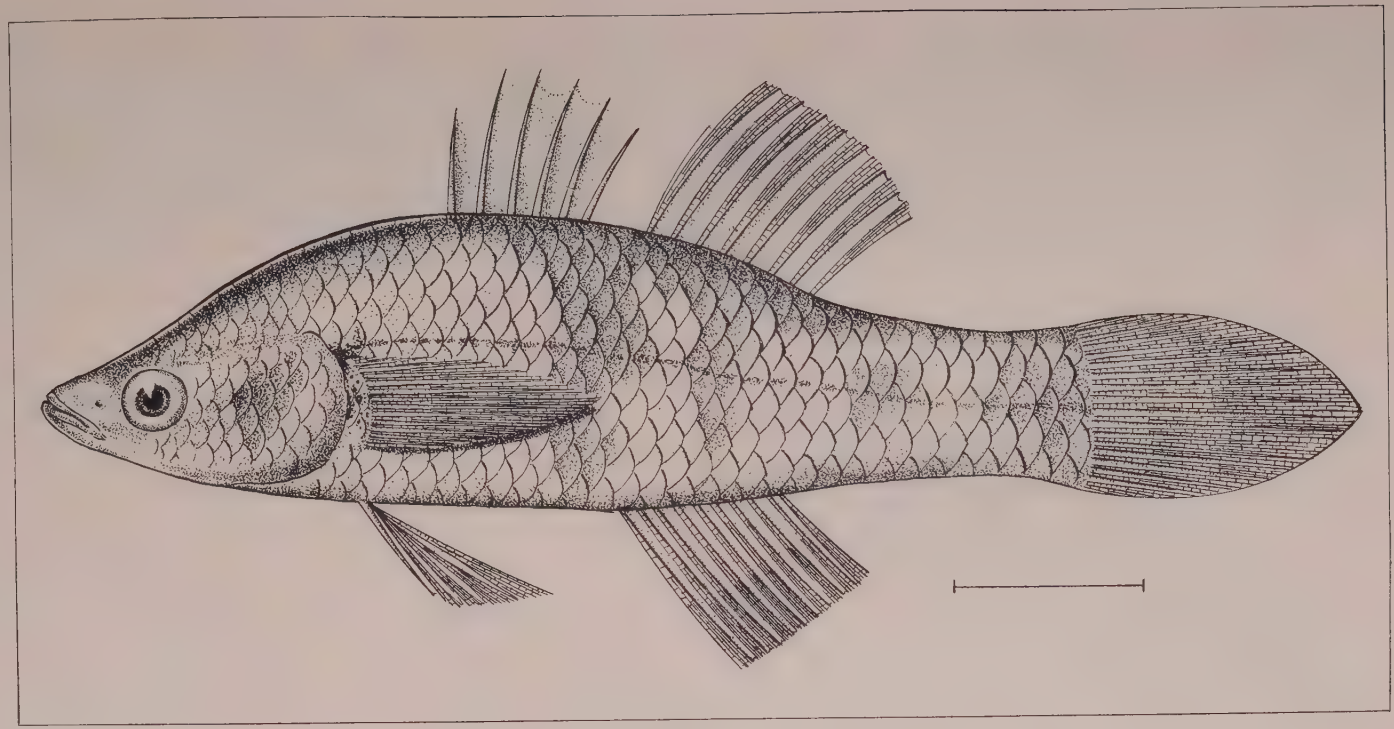

PLATE 1. HYPSELEOTRIS QUISUMBINGI SP. NOV.

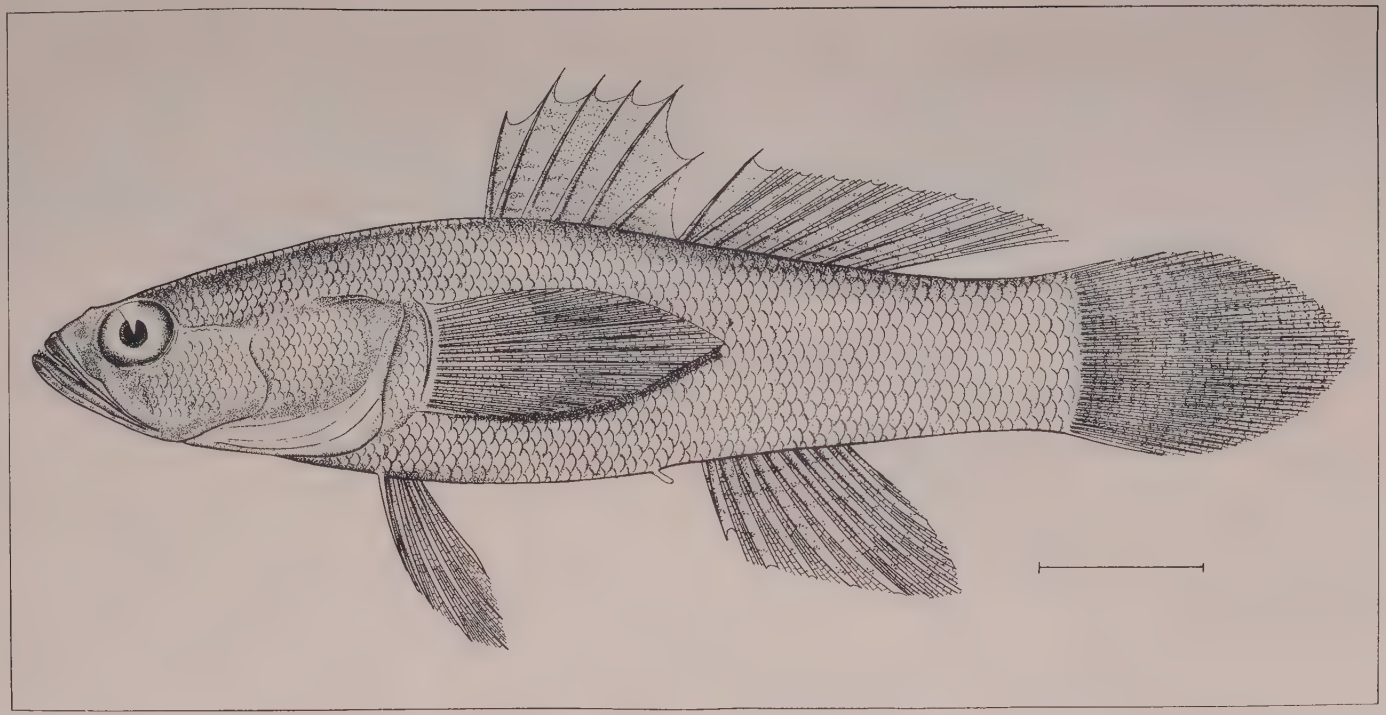

PLATE 2. BORODA FRANCOI SP. NOV.

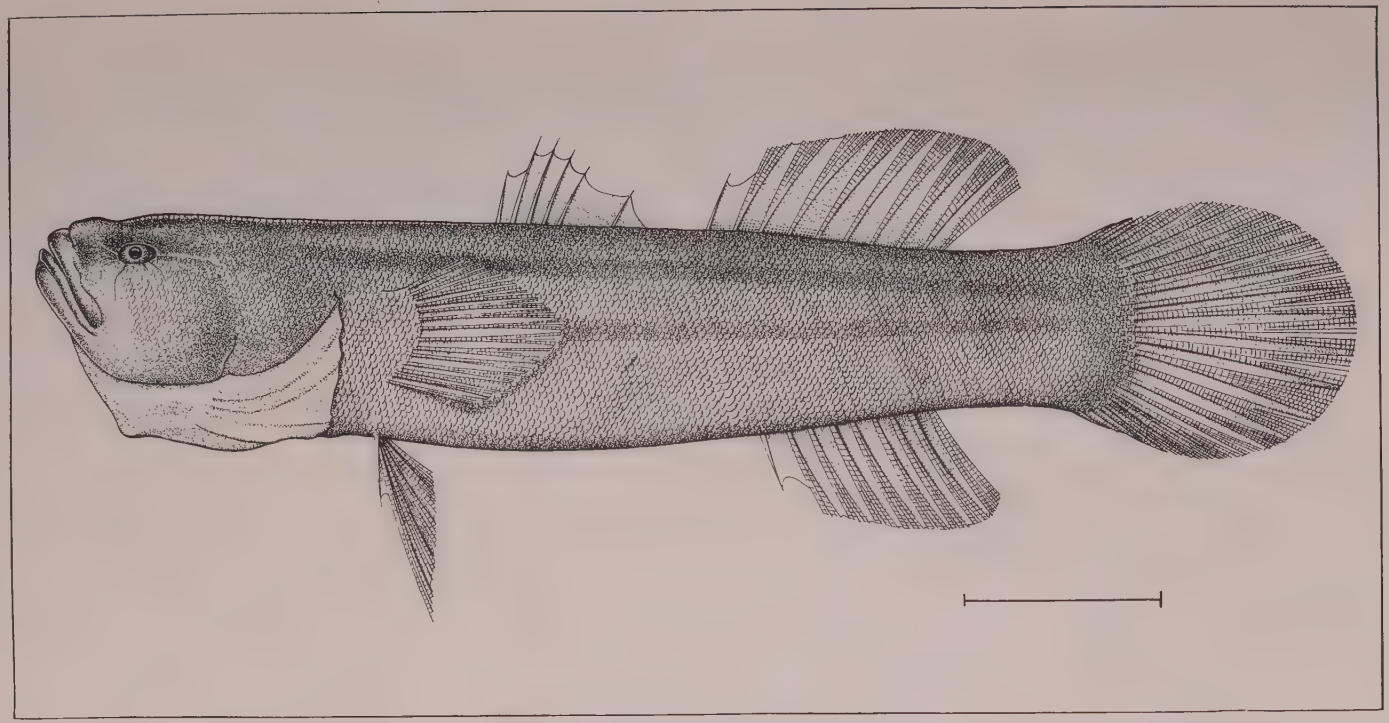

PLATE 3. PALOA VILLADOLIDI SP. NOV.

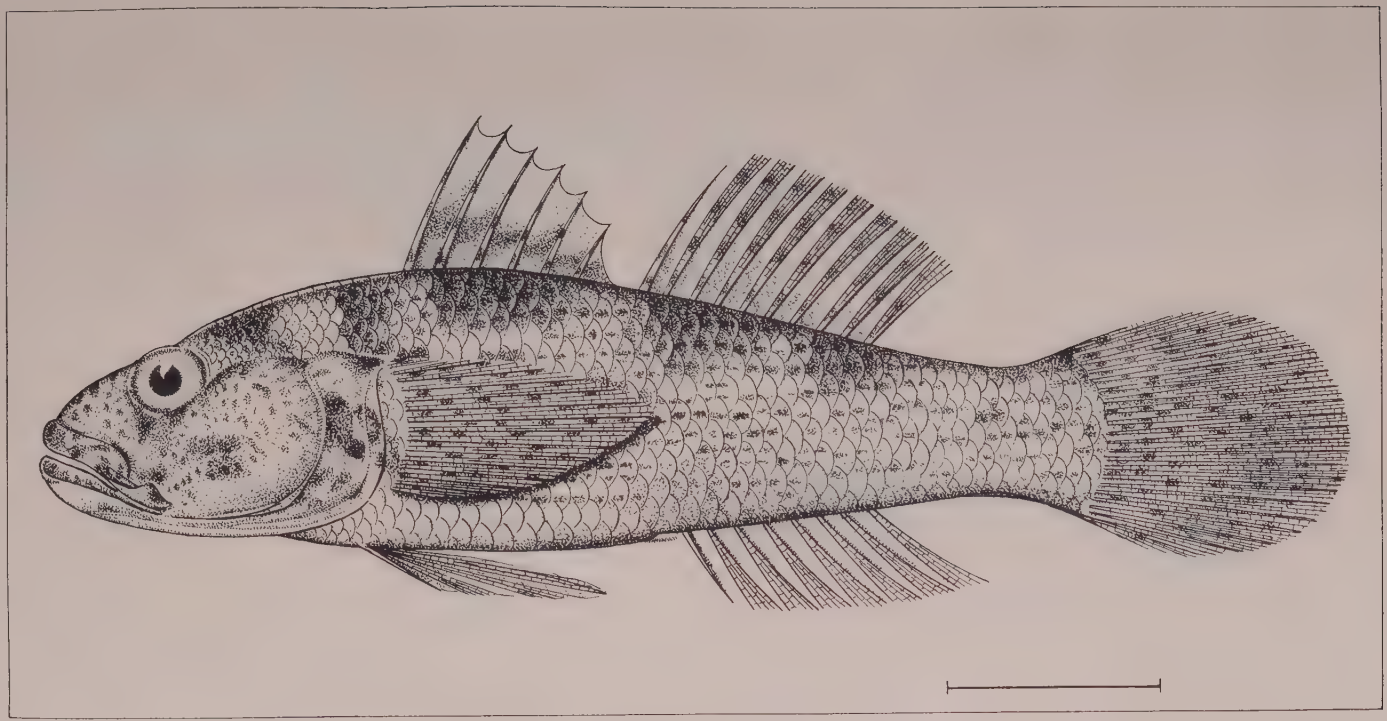

PLATE 4. BATHYGOBIUS LACÆ SP. NOV.

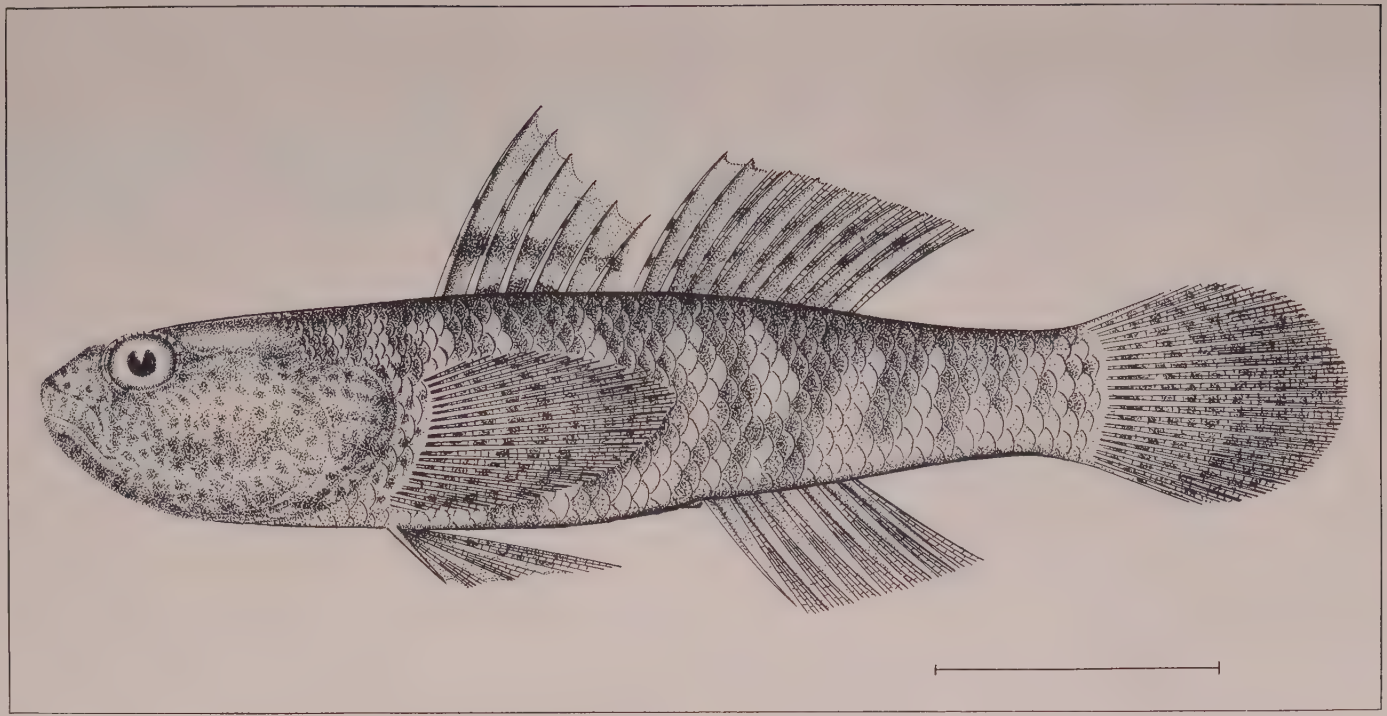

PLATE 5. BATHYGOBIUS BLANCOI SP. NOV.

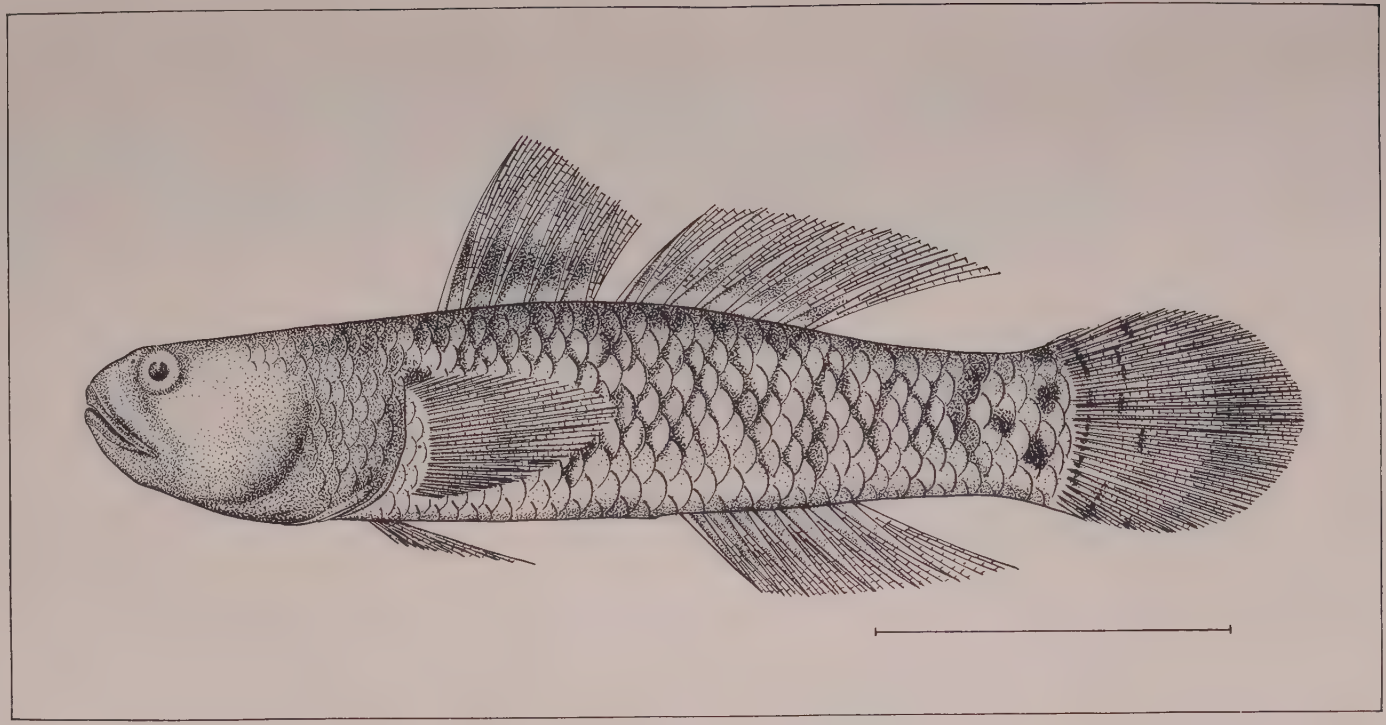

PLATE 6. MUGILOGOBIUS LUZONENSIS SP. NOV.

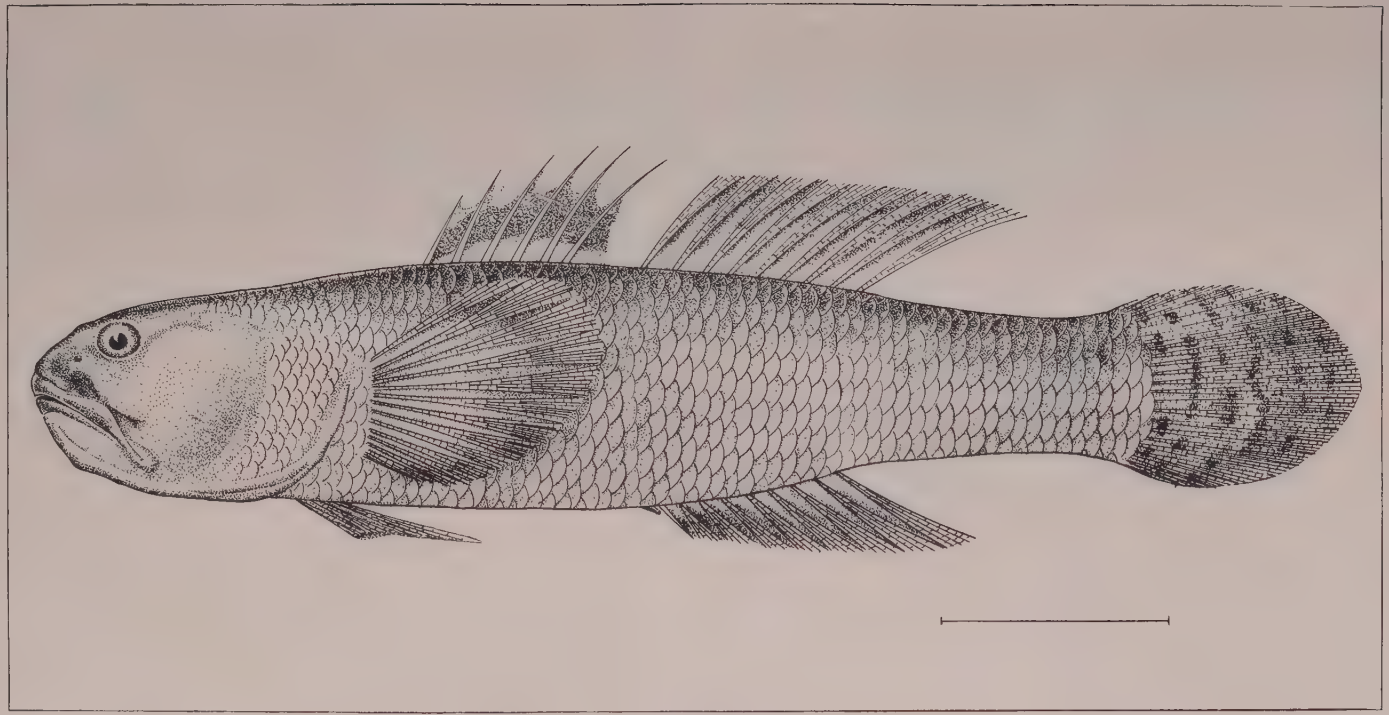

PLATE 7. TAMANKA ARGUELLESI SP. NOV.

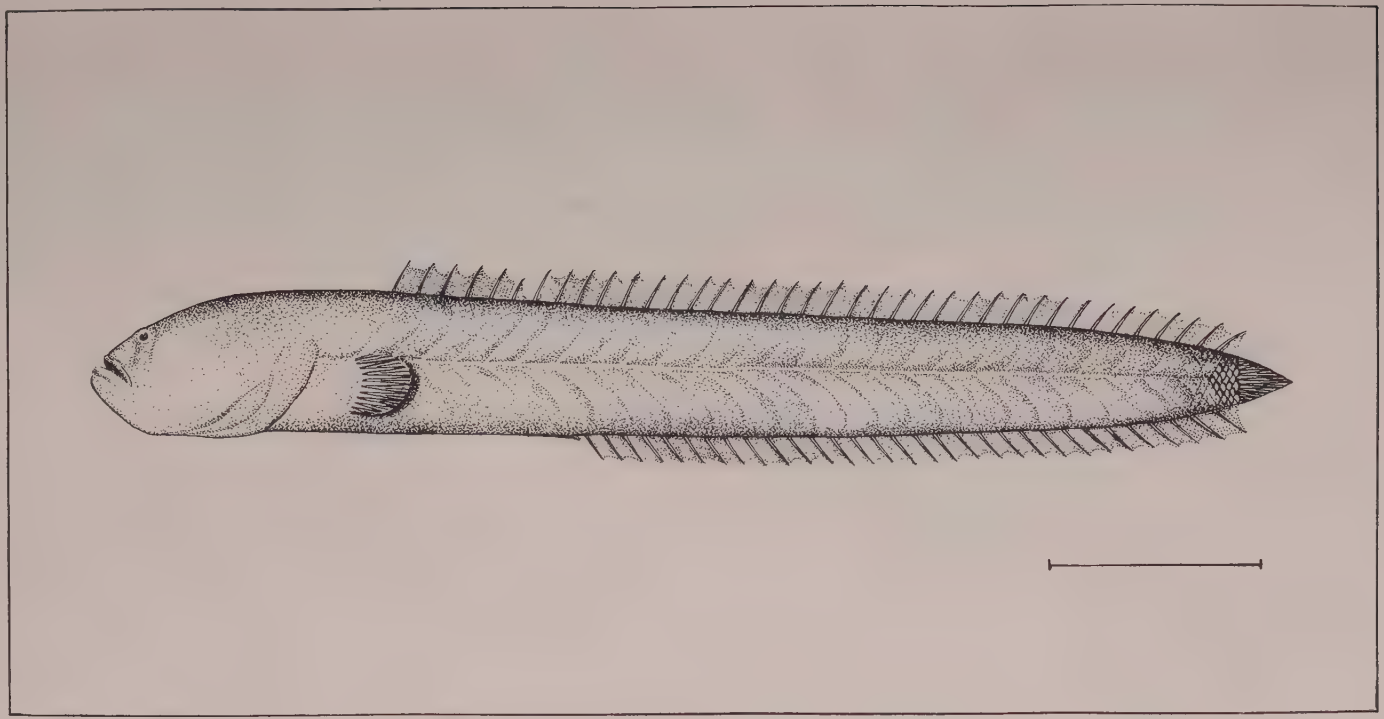

PLATE 8. NUDAGOBIOIDES MONSERRATI SP. NOV.

A NEW PHILIPPINE CUCURBIT-BORING BARID (COLEOPTERA, CURCULIONIDÆ)

By Elwood C. Zimmerman

Entomologist, Bishop Museum, Honolulu, Hawaii

ONE TEXT FIGURE

The material upon which this paper is based was presented to me for study by Mr. D. F. Fullaway, of Honolulu, after one of his trips to Manila.

The Barinæ have developed such a tremendous number of genera and species in the Neotropical Region that, principally because of the work of Casey and others, that region has come to be looked upon as the great developmental center of the subfamily. However, the actual situation is not altogether so one-sided as this assumption would lead one to believe, because the Oriental and Australian Regions of Wallace, especially the Indo-Malayan and Austro-Malayan Subregions, are extraordinarily rich in genera and species and probably rival the developments found in tropical America. However, the Pacific Barinæ have received little attention from taxonomists, and little is known of the fauna in literature. It is an established fact that the barid fauna of the islands from Fiji westward is greatly diversified and highly developed.

It is impossible for one to go far in a taxonomic study on the known Barinæ of the Pacific without having access to the old genera and species which are represented, more often than not, by uniques or small series in European museums. The Barinæ are a taxonomically difficult group, and little progress can be made in the study of the Pacific forms until a basic revision of the described forms has been prepared. Many of the genera are composite, and much revisional work is essential.

I am indebted to Dr. Gonzalo Merino, of the Bureau of Plant Industry of the Philippines, for adding some notes on the habits of the weevil to this paper.

In addition to the following new species, for which I have found it essential to erect a new genus, I have seen several other new species from Java that belong to the same genus.

Genus MANILABARIS novum

Head sharply separated from base of rostrum by a distinct transverse impression between tops of eyes; interocular area as broad as base of rostrum; eyes separated below by about breadth of rostrum. Rostrum evenly arcuate, gradually dorsoventrally and laterally narrowed from base to apex, slightly shorter from ventral basal angle to apex than median line of prothorax in genotype; antennæ inserted at about middle in both sexes (measured along lower edge, but two-fifths from apex if measured along dorsal edge); mandibles bidentate, decussate. Antenna with scape about as long as funicle excluding club, not reaching eye, separated from it for a distance about equal to length of funicular segment 2; funicular segment 1 as long as three following segments together, segments 2 to 7 successively more transverse; club ovate, shorter than funiculus, densely pilose throughout, sutures distinct, 4-segmented, segments not well defined, basal segment making up half the mass. Prothorax broader than long, base bisinuate, elytral bases fitting into grooves in basal margin, broadly rounded at sides, with a distinct subapical constriction, apical margin dorsally and laterally subtruncate. Scutellum distinct, not partially hidden by prescutellar lobe of prothorax. Elytra distinctly broader near base than near prothorax, humeri obtuse, prominent, each elytron slightly rounded at apex; 10-striate, stria 8 not reaching base. Legs with femora at most very shallowly grooved for reception of tibiæ, dentate or multidenticulate, hind pair reaching to apex of third or fourth ventrite; tibiæ multicarinate, sinuous, slightly expanded distally, uncus strong and arising from about middle of apex, without a tooth on inner apical angle; tarsi with segment 1 cone-shaped, longer than segment 2, segment 2 slightly transverse, shorter than segment 3 and hardly more than half as broad, segment 3 deeply bilobed, lobes rather slender and well separated, segment 4 as long as three preceding segments, claws well developed, free and divergent. Sternum with prosternum simple, not caniculate, anterior margin entire, intercoxal area flat, about as wide as transverse diameter of a fore coxa, median postcoxal area slightly produced over mesosternum; mesosternum on nearly same plane as metasternum, mesocoxæ separated for a distance about equal to twice breadth of a mesocoxa; mesosternal side pieces fused; metasternum between mid- and hind coxæ three-fifths as long as broad, metepisterna, metacoxæ as widely separated as mesocoxæ. Venter with first two ventrites fused, segment 1, measured along median line, about as long as segments 2 and 3, segment 2 longer

than segments 3 and 4 which are subequal, segment 5 to as long as segments 3 and 4 or slightly shorter. Pygidium transverse, conspicuously exposed in both sexes, nearly vertical or somewhat anteroventrally inclined, appearing as a sixth ventrite when viewed from below.

Genotype: *Manilabaris cucurbitæ* sp. nov.

This genus belongs to Lacordaire's Lyteriides of his subtribe Madarides in association with *Orchidophilus* Buchanan (1935), *Acythopeus* Pascoe (1874), *Myctides* Pascoe (1874), and *Cynethia* Pascoe (1874).

Manilabaris may easily be separated from *Orchidophilus* because of its medianly inserted antennæ (inserted at one third length from the apex in *Orchidophilus*). *Myctides* has a slender, different type of rostrum in which the antennæ are inserted postmedianly; it also differs in other characters. *Cynethia* has an apically dilated rostrum, and *Acythopeus* has edentate femora, and evidently the apex of the scape is more distant from the eyes than on *Manilabaris*.

MANILABARIS CUCURBITÆ sp. nov. Text. fig. 1, a to f.

Derm entirely black, antennæ and tarsi slightly infused with red; coarsely reticulate, but moderately shiny; without squamæ. dorsal setæ minute and inconspicuous.

Head densely and moderately coarsely punctured at base of rostrum, punctures there with interstices narrower than punctures, punctures becoming smaller and less dense toward top of crown, minute near prothorax; eyes twice as high as wide, lower hind edges contiguous to prothorax. Rostrum as high as broad at extreme base, gradually and slightly narrowed on sides from base to apex, slightly more expanded at antennæ and apex in female than in male; very densely, coarsely, subconfluently punctuate from base to beyond antennæ in male, but only to antennæ in female, thence smooth, shiny, and with only small, scattered punctures; without carinæ or sulci. Antennæ with scape gradually clavate, as long as first six funicular segments and part of segment 7; funicular segment 1 as long as segments 2 to 4, three-fifths as broad as long at apex, segment 2 hardly longer than 3, segments 3 to 7 successively more transverse, segment 3 three-fifths as broad as 7, segments 5 to 7 each with a whorl of stiff setæ longer than each segment, segments 2 to 4 with much shorter setæ; club as long or slightly longer than preceding four segments, two-thirds as broad as long to almost as broad as long, with scattered, longer, hairlike setæ in addition to the

short pile. Prothorax broadest at about basal third, there broader than long (2.9 : 2.4), evenly arcuate on sides from base to distinct subapical constriction, apex subtubulate, subapical constriction deeply impressed on sides but just perceptibly interrupting otherwise continuously convex, longitudinal, dorsal contour; very densely, coarsely, reticulately punctuate throughout, interstices obviously much narrower than punctures, discal punctures about half as broad as an elytral interval, larger and coarser on sides. Scutellum longer than broad, usually narrowed anteriorly and somewhat constricted. Elytra slightly

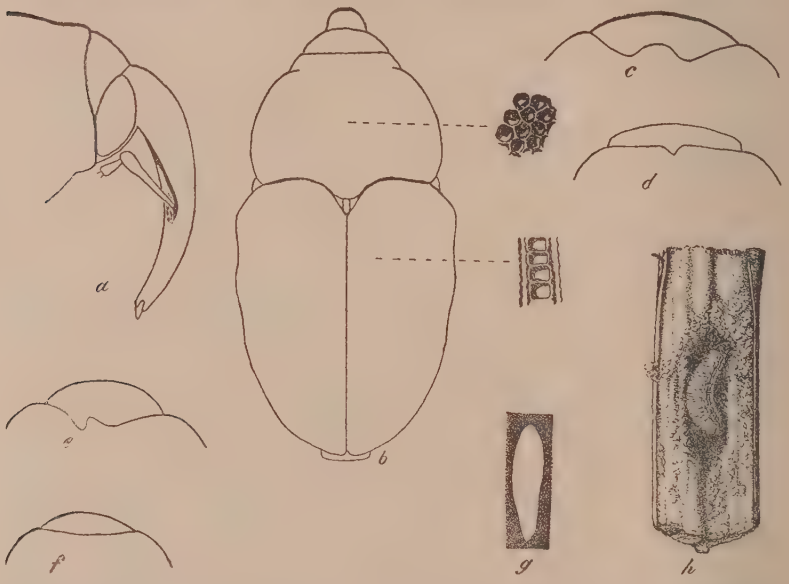

FIG. 1. *a* to *f*. *Manilabaris cucurbitæ* sp. nov. *a*, side view of head and rostrum; *b*, outline of holotype female; *c* to *f*, outlines of apices of ventrite 5 and pygidia as seen from below, showing variation in form; *c*, holotype, male; *d*, allotype, female; *e*, paratype, male; *f*, paratype, small female. *g* and *h*, cucurbit-boring barid, egg and larva, respectively.

more than twice as long as prothorax, broadest across humeri and there seven-ninths as broad as long, thence gradually narrowed to broadly rounded apex; striæ deep and well defined throughout, their punctures larger toward base and therewith slightly crenulating intervals, stria 10 complete and together with stria 9 almost joining striæ on disc, very densely set with conspicuous, subquadrate punctures which are almost as broad as intervals and are transverse on disc. Legs with femora very coarsely and densely punctuate throughout, each puncture bearing a pale, prostrate seta, shallowly and sometimes rather

vaguely impressed for reception on tibiæ, dentate or denticulate at sides of impression; tibiæ with coarse, punctuate, longitudinal sulci separated by narrow carinæ. Sternum with prosternum coarsely, densely, reticulately punctuate throughout, narrowest part of postcoxal area less than half as long as longitudinal diameter of a fore coxa, median postcoxal sclerite slightly longer from suture between coxæ than distance between coxæ, its hind margin just perceptibly concave; mesosternum coarsely and densely punctate; mesosternal side pieces densely set with very coarse punctures; metasternum with an impressed median line, very coarsely and densely punctate on sides, but with much smaller, more widely spaced punctures on disc, distance between mid- and hind coxæ equal to transverse (greatest) diameter of a metacoxa; metepisterna coarsely and densely punctured throughout, separating hind coxæ from elytra for a distance equal to longitudinal diameter of a metacoxa. Venter with first two ventrites broadly and shallowly impressed down middle in male, tumid and convex in female; punctures of entire abdomen less coarse than those on sides of metasternum, punctures coarser and closer on sides, finer and sparser toward middle; ventrite 5 with posterior margin variable, entire, medianly notched in female, or with an emargination on either side of middle in male. Pygidium more broadly visible from directly below in male than in female, densely punctuate throughout, vertical part subsemicircular in outline, strongly transverse.

Length, excluding head and rostrum, 2.50 to 3.25 mm; breadth, 1.25 to 1.75 mm.

Manila, Luzon, holotype, male, allotype, female, in Bishop Museum, and 11 paratypes taken from the stem of a cucurbit in 1938.

This species closely resembles the genotype (here designated, if not heretofore designated) of *Acythopeus* Pascoe. *A. tristis* Pascoe, as figured by Pascoe,[1] but Pascoe says in his generic description "Femora mutica . . .", whereas on *M. cucurbitæ* the femora are obviously dentate or denticulate. I have not seen *A. tristis*.

NOTES ON THE HABITS[2]

This weevil has been found by Mr. Andres Ponce of the Entomology Section of the Bureau of Plant Industry, Manila, to be

[1] Journ. Linn. Soc. Lond. 12 (1876) pl. 3, fig. 11.

[2] Supplied by Gonzalo Merino, of the Bureau of Plant Industry, Manila.

a serious pest of patola (*Luffa* sp.), ampalaya or bitter melon (*Momordica charantia* Linn.), and upo or white squash (*Lagenaria siceraria* (Mol.) Standley.

The eggs, which are pearly white, somewhat elongated, tapering at one end, and about 2 millimeters long (test fig. 1, *g*) are inserted by the weevil in the stem of the host plant, and upon emergence the larvæ (text fig. 1, *h*) begin feeding by boring in all directions in the soft tissue of the inner cells, causing the stems to hollow longitudinally, and finally killing the vine.

ILLUSTRATION

TEXT FIGURE

FIG. 1, *a* to *f*. *Manilabaris cucurbitæ* sp. nov. *a*, side view of head and rostrum; *b*, outline of holotype female; *c* to *f*, outlines of apices of ventrite 5 and pygidia as seen from below, showing variation in form; *c*, holotype, male; *d*, allotype, female; *e*, paratype, male; *f*, paratype, small female. *g* and *h*, cucurbit-boring barid, egg and larva, respectively.

PRESERVATION OF FISHING GEAR IN SAMAR PROVINCE, PHILIPPINES

By Santos B. Rasalan
Of the Division of Fisheries, Department of Agriculture and Commerce Manila

ONE PLATE AND TWO TEXT FIGURES

The deterioration of fishing gear is due mainly to organisms which it harbors and to which it serves as a source of food. Fishermen spend much time, energy, and money in killing and removing these organisms from their gear. Conn and Feliciano(2) estimated that for every dollar's worth of haul an American fisherman spends 2 cents for the upkeep of his gear and the purchase of extra gear with which to replace it while it is being cleaned and preserved, in order to avoid interruption in fishing operations. To minimize this loss, fishermen make use of every opportunity to mend torn parts, to kill and remove whatever growths have collected in their gear, and to dry the gear in order to make it resistant to some degree against the attack of destructive organisms.

Fishermen in foreign countries have various ways of preserving nets. The simplest method is by smoking. The antiseptic qualities of creosote penetrate the fibers and kill whatever organisms are located in them. Hot coal tar or tar thinned with oil of turpentine or linseed oil, or water-gas tar oil are sometimes used. The main objection against the tar method is that the tar is apt to "burn" the net; moreover, it makes the twine stiff, hard, and brittle, especially at the knots which are easily broken when stretched. In France fishermen use either a 2 to 4 per cent alum solution, or sulphurated copper, or zinc oxide. English fishermen add buttermilk to the alum solution. In Newfoundland a decoction of pine, spruce, or birch barks and tar, in the proportion of 20:1, is used. Swedish fishermen use birch bark solution alone, and the English, oak bark.

The most widely used tanning material is the *catechu*, of which the varieties gambier, and palm cutch, are best known. These are prepared by evaporating solutions made from the barks of gambier and acacia, and from betel palm nuts, respectively. In the United States cutch is prepared from the barks

of oak or hemlock; it is sold in the form of cakes which are oftentimes adulterated. A pure cutch can be distinguished by its brown color, a fatty or shiny surface on the broken parts, and its sweet aftertaste.

Various methods of using cutch are followed by different fishermen. The cutch is, however, invariably dissolved in boiling water and used while hot. The net is either dipped into the solution two or three times or allowed to remain immersed in it for from 6 to 12 hours, after which it is subjected to a fixing bath of linseed oil, lime water, or potassium bichromate. If linseed oil or lime water is used, the net is again soaked in the cutch solution to complete the tanning. The nets are usually tanned once every two weeks or at the close of every fishing month.

The Filipino fisherman also regards the preservation of his gear as necessary. Fishermen from Samar Province always set aside a certain part of every fishing month for mending and preserving their gear. Thus, even if it would be possible for them to fish daily the year round, except in days of stormy weather when the sea is rough, they fish only from the fifth day after the full moon to the fith day after the first quarter (*caudto*), or for 23 days for every 30-day period, leaving 7 days for the repair and tanning of nets. *Cubcub* net (purse seine) owners fish up to the first quarter only. Deep-sea fish corrals, however, are operated throughout the year, except those that are set in exposed places, which are removed or destroyed during the stormy part of the northwest monsoon (*habagat*). Such fish corrals are expected to last only until the end of the fishing season, if they are not destroyed sooner by strong waves or a typhoon. Shallow-water fish corrals are removed from the water at the end of every 30-day period for the purpose of removing whatever growths are found on the bamboo splints of the fences. This practice is possible because the removal and setting of this type of corral can be effected without much expense and effort.

Here presented are the methods used in preserving fishing nets, lines, and fish corrals, which are the most common fishing appliances used for catching fish in Samar Province. The methods used are simple but believed effective in augmenting the lives of gear by from 1 to 6 years.

METHODS OF PRESERVING FISHING GEAR

Samar fishermen preserve their gear to make them resistant to the attack of organisms that grow on them, and to make them more effective in the catching of fish. The latter effect is more apparent, it is believed, in cubcub nets which are tanned with blood. Observations have been made on this effect, and the result will be reported in a separate paper. Small nets are tanned with a decoction prepared from tan bark, and larger nets are treated with blood. Fish corrals are preserved by simply removing the organisms found growing on the bamboo splints which compose the fences, and drying.

Trawl and troll lines.—Trawling and troll fishing are common in Samar, although they are not used for catching fish on a commercial scale. Before use, the lines are tanned. A new line is washed first in fresh water and then dried by tying both ends to two posts, so that no part of it touches the ground. It is then subjected to preliminary tanning by rubbing with green leaves. The leaves are macerated and rubbed to and fro on the line until the line is colored. Then the green bark of *anagkong* [*Trema orientalis* (Linn.)], is applied. The bark is macerated or pounded until it becomes soft but not broken to pieces nor powdered before application. It is rubbed on the lines by hand until the color of the line is reddish or reddish brown. When the color becomes uniform, the line is allowed to dry, after which it is ready for use.

Often fishing lines are tanned with a decoction made from the barks of *tabigi* (*Xylocarpus granatum*) and *bakao* (*Rhizopora* spp.). The procedure is the same as that used in tanning nets. After tanning, the lines are completely dried before use.

Fish corrals (*bunuan*).—Fish corrals, locally known as bunuan, are among the most important fishing gear used for catching fish in Samar Province. They are made in various sizes and shapes, depending upon the depth of the water where they are set and on the taste of the owner. All are, however, made of rows of bamboo posts or stakes, with bamboo screens (*banata*) as fences. They are built in the form of inclosures with easy entrance but difficult exit for the fish. The deep-sea fish corrals (*paugmad*) are set as early as November or at the beginning of the northeast monsoon (*amihan*) and remain in position as late as July or during the early part of the southwest monsoon. The shallow-water fish corrals (*pahubas*) are set and removed

once every 30 days during any part of the year, especially when set in sheltered places. Sometimes a fish corral of this type is removed when a typhoon comes, to be reset after the typhoon has passed.

The care of a shallow-water fish corral is centered on the repair of broken parts and the removal of organisms growing on the bamboo splints of the banata. The organisms are mostly algæ, crustaceans, oysters, and infusorians. The work is done by the owner himself. The banata of a new fish corral are allowed to remain in position for 15 days. On the 16th day they are reset upside down, so that the parts which have been submerged become exposed. They remain in this position for another 15 days, after which they are removed and taken ashore. The banata are dried in the sun along the shore for one day or longer, after which they are again dipped into sea water when the organisms growing on them are scrubbed off by means of a specially made bamboo brush (text fig. 1).

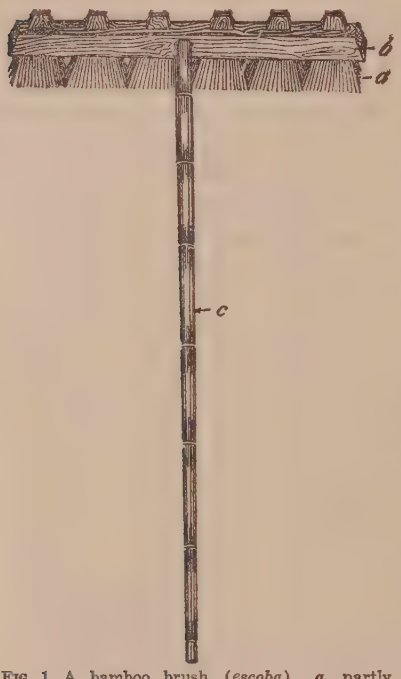

FIG. 1. A bamboo brush (*escoba*). *a*, partly split bamboo slats; *b*, wood; *c*, bamboo handle.

This brush is made of from four to six pieces of bamboo (text fig. 1, *a*) 2 inches wide and 1 foot long, and finely split at one end to about half the length. The unsplit portion is either joined or nailed onto a piece of wood (text fig. 1, *b*), 2 inches wide, 3 inches thick, and 16 inches long. This portion is in turn nailed crosswise at its middle on to one end of a bamboo 2 meters long and about 2 inches in diameter (text fig. 1, *c*). A finished brush has the appearance of a rake.

To facilitate the removal of foreign organisms, the splints of the banata are scrubbed to and fro in a longitudinal direction, on both sides, while the banata is submerged in shallow water along the shore. The mattings are then dried in the sun for one day or longer, and the torn parts repaired. After repair the

bamboo mattings are rolled and either set at once in the water or kept under the house or in the working shed (*camalig*) until they are used again. If this procedure is repeated once every 30 days the banata may last from one to two years.

The setting or removal of a deep-sea fish corral is arduous and expensive; hence the removal of organisms from the fences and posts involves much effort and expense. Sometimes it is found more expensive to remove and to reset an old deep-sea fish corral than to buy a new one. Therefore, once a deep-sea fish corral is set it is not removed from the water until it is destroyed or until the season is over. In order to make the fish corral last throughout the season, special care is taken in the selection of the materials used. Only well-seasoned bamboos are used for making the fences; *anahaw* (*Palma brava*) is used for the posts; and *hagnaya* (*Polygola venosa* Juss.) for the lacings of the fences and for other tying purposes. These materials last in water for over 6 months or even for a year, as long as the fish corral is not destroyed by a typhoon.

Cubcubillo and other small nets.—Cubcubillo is the local name of a round haul net of moderate size constructed and operated similarly to the *lampara* of Monterey, California.(4) This net is used in catching pelagic fishes of which mackerels, tunnies, and gizzard shads are the most important. It consists of two wings of 6-thread (3-strand) cotton webbed with a mesh of 5.5 cm stretched, and a central landing bag of 6-thread (3-strand) cotton twine webbed with a mesh of 5 cm stretched, and 24-thread (3-strand) cotton twine webbed with a mesh of 6 cm stretched. Each of the two wings is composed of two or three strips (*paños*) of from 500 to 1,000 meshes wide and from 4 to 12 fathoms deep. The strips are laced together with the bag at the middle, but when washed, dried, or tanned, the pieces are separated from one another.

Before use, the net is tanned. The strips are unlaced from each other and washed in fresh water, as oily and fatty substances often found on the net prevent the proper penetration of the tanning liquor into its innermost fibers. The net shrinks when it is washed. It is then dried on an elevated drying stand called *calaycayan* (Plate 1, fig. 1) for 4 to 5 hours. This calaycayan is made up of ten or more bamboos, each placed horizontally and supported by at least three posts 1 meter above the ground. The bamboos are placed parallel to each other at regular intervals. When a drying stand is not available, the net is dried on a clean sandy shore, along the sides of the road, or in

any open place behind the houses. The net is spread in the sun, and when it is completely dry, it is brought inside the working shed where the mending of the torn parts, if any, and the preparation of the tanning solution take place.

The tanning solution is obtained from the barks of trees known as *tabigi* (*Xylocarpus granatum*) and *bakaw* (*Rhizopora* spp.). These trees are found in mangrove swamps bordering tidal streams throughout the Philippines. The bark of one tree is always used with the bark of the other. When used alone, the decoction from bakaw bark imparts a red to dark-brown color, but makes the threads rather hard, stiff, and brittle especially at the knots, which makes them break easily. The tabigi bark imparts a lighter color but does not make the twine brittle. Since dark brown is the desired color, the decoction is prepared from a mixture of the two barks in the proportion of five parts tabigi to one part bakaw.

The tanning extracts of the barks are obtained by either boiling or soaking in well or spring water. In the latter case the barks are broken into small pieces and placed in a small dugout (*tabigi-an*). When the dugout is about ⅙ full of bark, water is added until the dugout is full. After 1 to 2 weeks the bark is removed from the solution, which is now ready for use.

To facilitate the extraction of tanning substance, the bark is sometimes boiled in 5-gallon tin cans. Small pieces of tabigi and bakaw barks are put in a tin can until this is full. Water is added to the contents of the can until full and boiled for 3 to 4 hours or until the can is only half full of the solution. The decoction thus produced is poured into a small dugout, and the bark is thrown away. The procedure is repeated until the dugout is nearly full of the decoction. The solution is allowed to cool before the net is dipped into it. Rain water is never used in the preparation of the decoction, as it is said to have a bad effect on the net. Well or spring water is invariably used.

The strips of nets are dipped into the decoction one after the other. In the dipping, the float line is usually placed first, especially when the tabigi-an is small and cannot accommodate a whole net at a time. If the dugout is large, the whole net is dipped at once. Additional solution is poured over the net in case some portions are not entirely immersed. This dipping is repeated two or three times until the net is uniformly colored. The net is then spread in the calaycayan to dry in the sun. The process of dipping and drying is repeated 3 or 4 times, until

the desired dark-brown color is obtained. After the strips are dried for the last time they are laced together to make the net, which is later carefully folded on a platform (*papag*) at the afterdeck (*popa*) of the dugout (*cubcubillo-an*).

Tanning of the net is done once every 17 days or at the end of every fishing month. The fishermen who have ready prepared solution, however, tan their nets every now and then as they come from a fishing trip. Salting the net after use is not practiced. Instead, the net is washed in sea water to remove the slime of fish adhering to it, and dried immediately in the sun. If the net is tanned at the end of a fishing month, it is first washed in fresh water, dried, brought into the working shed, mended, and then tanned by following the procedure described above.

The expenses incurred in tanning one cubcubillo net at the close of a fishing month of operation are as follows:

Item.	Pesos.[1]
19 sacks of tabigi bark	3.80
1 sack of bakaw bark	.20
10 empty petroleum cans	1.50
Firewood	1.00
Total	6.50

Small or light nets, such as the cast net (*dala* or *laya*), dip nets (*sodsod, solambao* or *canay,* and *cabiao*) ; gill nets (*malawa, salibut, kayagkag, banata, and pante*) ; and other seines (*baring, bahan,* and *ligcop*) are tanned in the same way as the cubcubillo.

Round-haul net (*sapiao or lawag*) *and purse seine* (*cubcub*).—*Sapiao* or *lawag* and *cubcub* nets are the most important commercial fishing gear used in Samar Province. The former is a round-haul net operated with a powerful incandescent light, while the latter is a purse seine. Sometimes the latter is not pursed at the bottom line when used, so that it is transformed into a round-haul net similar to the lampara net used on the Pacific coasts of the United States.(4) Unlike sapiao, however, it is not operated with light. Both are used for catching pelagic fishes during the dark of the moon. Sapiao nets catch mostly anchovies, sardines, herrings, and other fishes which may be attracted by light. Cubcub nets are used for catching mackerels, gizzard shad, and sometimes tunnies.

[1] One peso equals 50 cents United States currency.

The method used in preserving sapiao and cubcub nets is the same as that used in preserving cubcubillo and other nets. However, aside from tanning the nets with tabigi and bakaw bark, coating with blood is also practiced. The nets are washed in fresh water, dried, and tanned with a solution of tabigi and bakaw barks. They are then used for one fishing month, after which they are again washed in fresh water and dried in the sun. After they are mended or repaired they are dipped into a prepared solution of tabigi and bakaw bark, and dried again. They are then ready for blood coating.

A cubcub net coated for the first time with blood requires about 100 gallons of blood. Sapiao nets, which are smaller in size, require less blood. Older nets, which have already been blood-coated for several times also require less blood. Although small quantities can be obtained from the butchers at Catbalogan, Samar, most blood is imported from either Manila or Tacloban, Leyte.

Unlike sapiao nets, the floats and sinkers of cubcub nets are not removed when dipped into the blood. Strips of the latter are merely unlaced from each other to make them lighter and easier to handle.

The blood is placed in a sack and squeezed into a dugout, rendering the coagulated particles finely ground and watery. Sometimes small amounts of fresh water are added. When all the blood is squeezed through the sack, the net is dipped into it. The blood is made to coat the twine uniformly and then dried in the sun, care being taken not to have the net wet with rain or fresh water. Over-drying is also avoided so that the blood does not crack. It is claimed that if the twine is rinsed with fresh water, it easily breaks when stretched or used, due to the decaying action of bacteria and other organisms found in the blood which are greatly activated in a moist medium. These bacteria penetrate rapidly into the fibers which serve as their food. The attack is, however, arrested when the net is dried in the sun right after soaking in the blood. The bacteria are killed when the net is steamed later. There are, however, cases when rain suddenly comes while the net is in the process of drying. If the net is not covered immediately and the condition of the weather does not warrant immediate drying, it is dipped again into sea water to remove whatever particles of blood remain in the net, otherwise the latter is spoiled. The net will then require a recoating with blood.

A new net requires at least two blood dippings. Older nets which have already been coated with blood for several times need only one dipping. The net assumes a dark chocolate color when dried. It is then carried to the working shed while preparations are being made for steaming.

The apparatus for steaming the net (text fig. 2) includes a barrel-like basket, locally known as *coloban* (text fig. 2, *a;* Plate 1, fig. 2), mounted on a large kettle (*cawa* or *sinoblan*) (text fig. 2, *b*), placed over a pit dug in the ground (text fig. 2, *c*). The coloban is 3.5 meters high, 90 centimeters in diameter at the opening, 1 meter in diameter at the base, with 1.5 meters as its greatest diameter. It consists of two closely-woven bamboo baskets, one closely fitting inside the other, with buri-palm lining between them. The buri palm covers every possible opening between the splints where the steam may escape. Hence, the opening at the top is the only exit for the water vapor coming from the boiling water in the kettle. The top is also covered with either cloth or sisal matting which partly prevents the escape of water vapor.

The kettle is made of iron, about 1 yard in diameter at the mouth and 1.5 feet deep. The pit is dug in the ground to fit the kettle. This pit is provided with an exhaust for the smoke and another opening where fuel is introduced.

The coloban is set in such a way that it is about 2 feet above the kettle, to prevent it from being burned during the steaming. A tin plate (text fig. 2, *d*), usually made of empty petroleum cans cut lengthwise, is formed into a circular chamber that encircles closely the base of the coloban a foot below. Green banana sheaths (text fig. 2, *e*) are placed around the coloban where it rests on the circular tin plate. The coloban is supported by wooden or bamboo horizontal bars (text fig. 2, *f*), which are in turn reenforced by four wooden or bamboo posts (text fig. 2, *g*). Sometimes the coloban is also tied to a tree or to the beams of the camalig for better support.

When the steaming system is properly set, the net is placed inside the coloban, the float line first, followed by the body and the lead line. The opening is then covered with either sisal matting or a piece of cloth at the top. Spring or well water is poured into the kettle until it is filled. Fire is built under the kettle in which the water is kept boiling continuously for 12 hours. Additional water is poured into the kettle from time to time to avoid scorching the net. After steaming, the net is

removed from the coloban and dried in the sun. After drying the net assumes a blackish-red color, which becomes darker and darker as the net is blood-coated repeatedly.

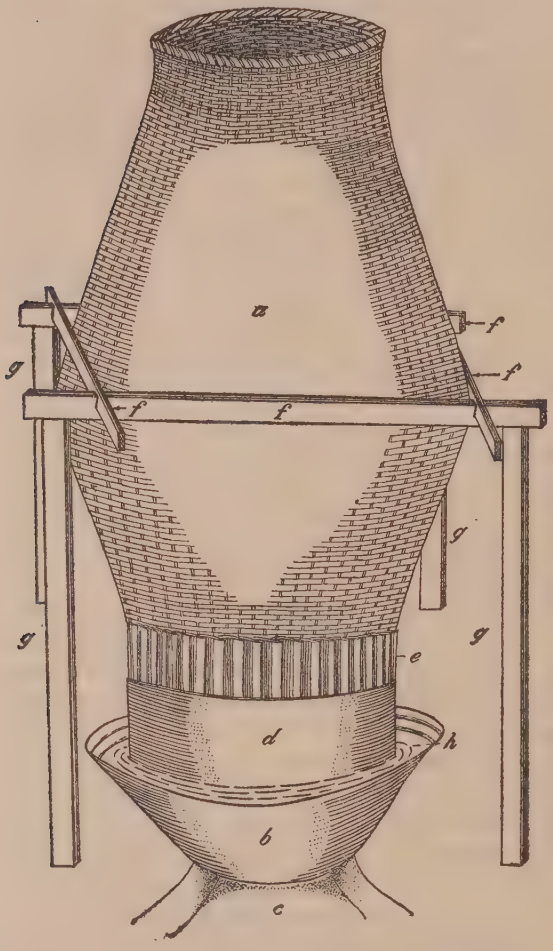

FIG. 2. A diagram of the apparatus used for boiling nets. *a*, coloban; *b*, kettle (cawa or sinoblan); *c*, pit; *d*, tin plate; *e*, banana sheaths; *f*, horizontal bars; *g*, bamboo or wooden posts; *h*, water.

A fixing bath follows the blood-coating. The net is soaked in the solution of bakaw and tabigi bark once or twice and dried after every dipping. When the preservation process is completed, the thread or twine becomes hard and stiff but not brittle, so that it becomes difficult for microörganisms to find their way into the inner fibers of the twine.

The lacing together of strips requires much skill, especially in lacing two strips which have different sizes of mesh. The strips must hang evenly from end to end and not full in one place and tight in another. When all the strips are laced together forming a rectangular piece, the net is folded nicely on a special platform or on the afterdeck of the banca.

Blood-coating is usually done once every 3 months during the earlier life of the net. The intervals may be lengthened

after the third treatment. The net is tanned, however, with bakaw and tabigi bark at the end of every fishing month. Sprinkling salt on the net is not practiced, even if drying is not completed within 24 hours. Instead, the net is thoroughly washed in seawater to remove the slime of fish, and covered with cloth (*trapal*) inside the banca.

Sapiao or cubcub nets tanned with a decoction of tabigi and bakaw bark and coated with blood can last from four to six years.

The approximate expenses incurred in tanning cubcub nets with bakaw and tabigi barks and coating them with blood are as follows:

Item.	Pesos.
20 bundles of tagibi bark	4.00
5 bundles of bakaw bark	.80
10 empty petroleum cans	1.50
20 5-gallon cans of blood	40.00
Firewood	1.40
Total expenses	47.70

CONCLUSIONS AND RECOMMENDATIONS

1. Fishermen of Samar preserve their gear by making them resistant to the attack of microorganisms growing on them. Light nets and fish lines are tanned with tabigi- and bakaw-bark solutions. Heavier nets, like sapiao and cubcub, are both tanned and blood-coated. Blood makes the net heavier and darker in color, and the twine firm and hard but not brittle. Shallow-water fish corrals are preserved by simply removing whatever growth is found on the bamboo splints once every 30 days.

2. The practice of drying the net along the road or on the beach without the use of a drying stand is unwise. Here the net is trampled upon by men and loose animals, so that it becomes dirty. Furthermore, the net comes in contact with the soil which contaminates it with harmful organisms. The use of a drying stand is always advisable.

3. Drying the net directly in the sun should, as much as possible, be discouraged. Quick drying tends to make the thread brittle. The best result can be obtained when the net is dried by hanging in the shade, especially when the air is dry and the day windy.

4. During rainy days, when the height of the fishing season occurs, the net cannot be properly dried. It is usually simply

kept wet in the banca covered with cloth. Under such conditions the nets rot easily if not sprinkled with salt.

5. The practice of cold tanning should be discouraged. With this practice penetration is slow and the net has to be dipped into the decoction three or four times before the desired color is attained. The action is more rapid if the decoction is used hot.

6. Many people believe that bakaw and tabigi barks are the only barks suitable for tanning nets. As these barks are used exclusively their prices become high. There are other trees in Samar the bark of which can also be used. Table 1 gives a list of trees found in Samar the bark of which can be used for tanning fishing nets and other appliances, together with the color they produce.(7)

TABLE 1.—*Trees in Samar the barks of which can be used for tanning fishing nets.*

Name in Samar dialect.	Scientific name.	Color produced.
Anabiong (Anagkong)	*Trema orientalis* (Linn.) Blume	Reddish brown.
Antipolo	*Artocarpus blancoi* (Elm.) Merr.	Reddish gray.
Aroma	*Acacia farnesiana* (Linn.)	Dark blue to black.
Baringbing	*Peltophorum inerme* (Roxb.) Llanos	Reddish brown.
Binonga	*Macaranga tanarius* (Linn.)	Do.
Chico	*Achras zapota* (Linn.)	Red to dark brown.
Dalinsi	*Terminalia pelucida* Presl	Dark blue.
Dungon	*Heritiera littoralis* Dryand	Reddish brown.
Gapas	*Ceiba pentandra* (Linn.)	Red to brown.
Gaway-gaway	*Sesbania grandiflora* (Linn.)	Brown.
Gogo	*Entada phaseoloides* (Linn.)	Khaki.
Kalamarina	*Leucaena glauca* (Linn.)	Brownish red.
Kamanchile	*Pithecolobium dulce* (Roxb.)	Brownish gray.
Lobi	*Cocos nucifera* (Linn.)	Blue.
Lomboi	*Eugenia cumini* (Linn.)	Reddish pink.
Santol	*Sandoricum koetjape* (Burm. f.) Merr.	Reddish brown.
Talisai	*Terminalia catapa* (Linn.)	Brownish to bluish.

The use of tan barks and blood coats for preserving nets and other fishing appliances is rather expensive, considering the limited catch that each fisherman has at the end of every fishing month. The same is true also in other countries, so that the United States government, through the Bureau of Fisheries, has been undertaking a series of researches to find a good and cheap means of preserving nets. As a result there have been developed(5) new copper mixtures which can be used cheaply and which give lasting effect. These should also be tried in the Philippines and if found better or cheaper or both, than the present methods, they should be adopted locally. The study should not be confined to gear used only in salt water,

but should include also that used in fresh water. Fresh-water fishermen doubtlessly have similar problems with their nets, which merit immediate consideration.

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ILLUSTRATIONS

TEXT FIGURES

PLATE 1

1

2

PLATE 1.

THE CATCHING OF LIVE BAIT FOR TUNA FISHING IN MINDANAO

By Jose S. Domantay

Of the Division of Fisheries, Department of Agriculture and Commerce Manila

FOUR PLATES AND TWO TEXT FIGURES

Live-bait fishing is the method usually employed by the Sea Foods Corporation of Zamboanga Province and by the Davao Fishery, Incorporated, of Davao Province, for catching tuna. The Sea Foods Corporation has three regular stations for live bait; namely, station A at Talusan, Margosatubig; station B at Gumalarang, Basilan Island; and station C at Tantawan, Margosatubig. The first station was established at Margosatubig, Igat Bay, but it was abandoned due to the marked depletion of sardines at that locality. Temporary stations for live bait are also established at Sibuco, Port Holland, Lumarao, Naga-naga, Maligay Bay, Olutanga, Brubay, Siasi, Tumbagaan Island, and other places. In these places fishing is occasional, depending upon the prevailing monsoon and the run of sardines.

At stations A and C fishing for live bait is carried on throughout the year, while at station B it is engaged in only during April and May. For all these stations the best months for live-bait fishing are April and May. The number of persons employed in each station are: station A, 1 Japanese and 23 Filipinos; station B, 6 Japanese and 22 Filipinos; station C, 1 Japanese and 15 Filipinos.

The live bait used for tuna fishing is mostly composed of sardines, namely *Sardinella leiogaster* (Cuvier), *Sardinella perforata* (Cantor), *Sardinella fimbriata* (Cuv. & Val.), and *Sardinella melanura* (Cuv. & Val.). Other species are also used as live bait; such as, *Scutengraulis mystax* (Bloch), large anchovies of the species *Stolephorus indicus* (van Hasselt); some small scombroid and carangoid fishes of the species *Rastrelliger chrysozonus* (Rüppell), *Scomberoides toloo* (Cuv. & Val.), *Megalaspis cordyla* (Linnæus), and *Selar crumenophthalmus* (Bloch); *Atherina duodecimalis* (Cuv. & Val.) and another species of the same genus; species of round herrings, *Dussumieria hasseltii* (Bleeker), and *Sphyræna obtusata* (Cuv. & Val.). *Sardinella*

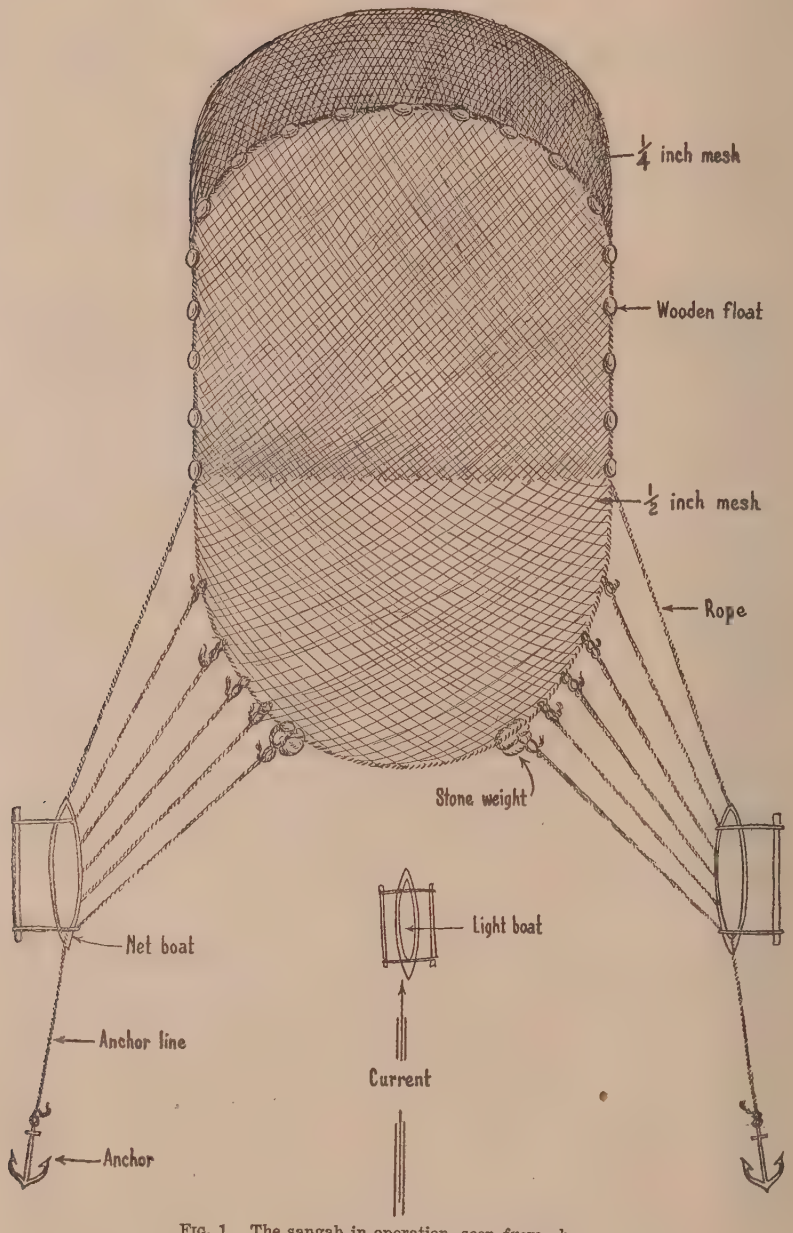

FIG. 1. The sangab in operation, seen from above.

leiogaster and *Scutengraulis mystax* are usually preferred as bait because they are hardy and can live long inside the bait wells of the boat. The latter species is the most abundant and is found around Siasi and neighboring places of the Sulu Archipelago. Next in abundance are *Sardinella perforata, S. fimbriata,* and *S. melanura.* In the absence of sardines, other fishes are used as bait in fishing for tuna. *Sardinella perforata* and the two species of *Atherina* are usually available throughout the year. Small specimens of *Rastrelliger chrysozonus, Selar crumenophthalmus,* and large *Stolephorus indicus* are caught during the rainy season, from July to October; *Sardinella fimbriata* from June to November; *Sardinella leiogaster* from March to June,

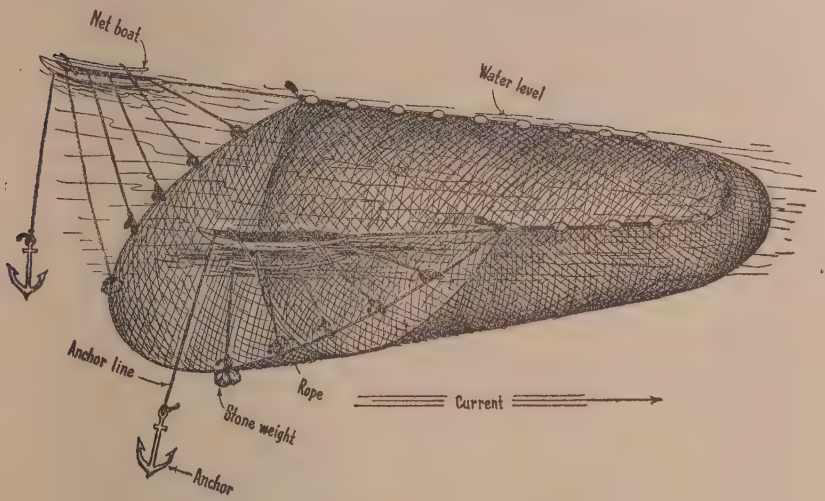

FIG. 2. The sangab in operation, perspective view.

and *Scomberoides toloo, Sphyræna obtusata, Megalopsis cordyla,* and others, from September to December.

The live-bait fishing outfit of the Sea Foods Corporation is composed of a luminous fishing lamp, light and net bancas, a net locally known as *sangab* (text figs. 1 and 2), and the net and wire tanks where the live bait is kept in captivity before it is taken into the bait wells of the fishing boat. That of Davao Fishery, Incorporated, is composed of a luminous lamp, a small motor boat, two sampans, and a *chinchorro* net.

The luminous lamp used is either a Petromax or Maxim type of from 1000 to 1800 candle power. The banca with the light is an ordinary *vinta,* a dugout with two outriggers. It is 7

meters long, 50 centimeters wide, and 50 centimeters deep. It is provided with a crosspiece of wood at the bow, where the lamp is hung. The banca with the net is larger and longer than the light banca. It has only one outrigger.

The net, locally known as *sangab*, a modified *lawag*, is always used with fishing vintas and luminous lamps. It is a fishing net about 20 meters wide and about 150 meters long. The part serving as the pocket has a mesh of $\frac{1}{4}$ inch, has three sides, and is provided with large cork or wooden floats. The other parts of the net, serving as the floor and leader that guide the fishes into the bulging end, have a mesh of $\frac{1}{2}$ inch and are weighted with large pieces of stone at the two front corners. The sangab is usually set in waters from 10 to 15 fathoms deep, and against the current, so that the pocket is properly stretched and held wide open.

The net tank, made of net of $\frac{1}{4}$-inch mesh, has a diameter of 6 fathoms and a depth of 2 fathoms. It is buoyed by a hexagonal wooden float and is used for storing live bait in the sea. The fishes become accustomed to the net tank after having been in it from 2 to 3 days. They are then transferred into the wire tank made of galvanized iron wire netting usually painted black. It is about 12 cubic feet and is buoyed up by wooden bars placed as floats about 2 feet from the rim. Here the live bait lives as long as one month or more. The bait fishes are fed occasionally with crushed fresh anchovies. Formerly large bamboo baskets, about 1.5 meters in diameter and 3 meters deep, were used for keeping live bait. This, however, proved neither practicable nor successful, as the fishes become injured as they bump their snouts against the bamboo-matting walls.

Method of fishing.—The sangab is placed against the current in waters about 20 fathoms deep or deeper. The fore part of the net without floats sinks to the bottom and is held by two or more large stone weights at each corner. These weighted parts of the net are suspended by six pull ropes to the side of the banca anchored at the side of the net. Each pull rope is taken care of by one fisherman. In each banca are usually six fishermen who manipulate the net as soon as the fishes are led inside by the bancas with light. The fishermen in each banca help each other in the manipulation of the net and in

transferring the fishes caught from the sangab into the net tank with the aid of the luminous lamp.

Eight or more bancas, each with a luminous lamp, are stationed at different places, at intervals of 200 meters or more, some distance from the net, to attract fishes. In each banca is a fisherman. When a school of sardines or other fishes suitable as live bait are attracted by the light, the banca is paddled slowly toward the net. The fishes follow the light and ultimately enter the net. As soon as the fishes have passed the sunken portion of the net, the fishermen in the two anchored bancas begin to pull up the ropes suspending the weighted portion of the net, enclosing the fishes. The trapped fishes are led into the net tank with the aid of a luminous light as follows:

At the rear end of the fishing net a net tank is placed. A luminous lamp is placed at the farther end of the net tank to attract the fishes. Some fishermen lower the edges of the two nets to allow the fishes to pass into the net tank. In this way all the fishes in the fishing net are conveyed into the net tank without the use of a dip net.

The Davao Fishery, Incorporated, does not have a definite station for live bait. At about 2 A. M. a launch, M/L "Nena", usually tows two sampans and a small motor boat to the live-bait fishing ground, which is not far from the mouth of Davao river, between the mainland and Samal Island. The tuna fishermen in the launch do the actual fishing for live bait, unlike the case in the Sea Foods Corporation, where the tuna fishermen are different from those that catch the live bait. The chinchorro used by the Davao Fishery, Incorporated, is of Japanese make. It is 150 fathoms long and 6 fathoms wide. It is placed in the two sampans before fishing. The small motor boat of the sampan type is provided with a luminous lamp to attract sardines. When a school of sardines is attracted, the signal is given to the banca with the net to pay out the net. The lower end of the net is then pulled by the other sampan to enclose the sardines. When the school of sardines is fully enclosed, the net is hauled and the catch is transferred into the bait wells of the tuna fishing boat. Buckets and dip nets are used in transferring the live bait from the chinchorro net into the bait wells. Table 1 shows the places, months, and the number of cans of live bait fished by the Sea Foods Corporation.

TABLE 1.—*Place, month, and number of cans of live bait fished by the Sea Foods live-bait fishermen.*

Place.	Month.	Bait.	Number of cans.
	1937		
Olutanga	August	Tamban	10.0
Naga-naga	do	do	18.0
Olutanga	September	do	56.0
Naga-naga	do	do	171.0
Talusan	October	do	60.0
Naga-naga	do	do	104.5
Talusan	November	do	865.0
Do	December	do	66.0
	1938		
Naga-naga	January	do	144.5
Margosatubig	do	Dulong-dulong	20.0
Lumarao	do	Gono	25.0
Igat Bay	do	Tamban	19.0
Malibay Bay	do	do	4.0
Naga-naga	February	do	156.5
Margosatubig	do	Dulong-dulong	60.0
Tantawan	do	Gono	27.0
Naga-naga	March	Tamban	8.0
Margosatubig	do	do	33.5
Gapic	do	do	105.5
Tibubaroga	do	do	24.0
Maluso	do	Gono	105.0
Tamuk Island	do	do	50.0
Margosatubig	April	Tamban	528.0
Sibuco	do	do	254.0
Margosatubig	May	Bolinao	54.5
Do	do	do	75.0
Sibuco	do	Matang Baca	80.0
Gumalarang	June	Tamban	270.5
Do	July	do	71.0
Talusan	do	do	742.0
Gumalarang	August	do	231.0
Talusan	do	do	456.5
Margosatubig	September	do	69.5
Talusan	do	do	165.0
Port Sibulan	October	do	316.5
Siasi	do	do	25.0

ILLUSTRATIONS

PLATE 1.

PLATE 2.

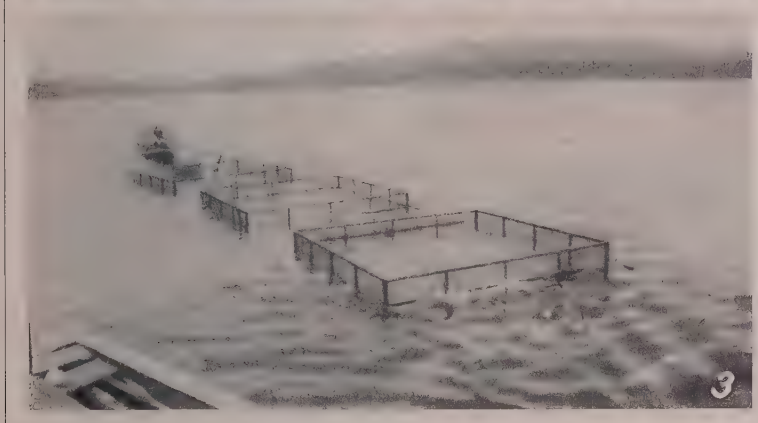

PLATE 3.

PLATE 4.

OLEANDRID FERNS (DAVALLIACEÆ) OF NEW GUINEA

By Edwin Bingham Copeland
Of the University of California, Berkeley

TEN PLATES

This is the first report on the ferns collected by the "Third New Guinea Expedition, American Museum of Natural History, Mr. Richard Archbold, Leader (Indisch-Amerkaansche Expedite)." The collections were made by L. J. Brass, or by L. J. Brass and E. Myer-Dress, about the summit of Mount Wilhelmina; citations are by collectors' names and numbers. The fern collections are more than 900 in number, and the collection is as remarkable for quality as for size.

In this first report I list all collections in the group. It is not my purpose ever to publish a full list of the collections, or keys to the New Guinea species of all genera, which would seem needless in groups recently monographed.

A list of the New Guinea ferns, as known to Brause in 1920, is published in Botanische Jahrbücher 56 (1920) 32–250. On the incomparable fern wealth of New Guinea, *see* Christensen's "Botanical Results of the (First) Archbold Expedition, No. 8" Brittonia 2 (1937) 265–317. The Second Archbold Expedition worked in low country; its collections are yet to be studied.

Genus OLEANDRA Cavanilles

Key to the New Guinea Species of Oleandra.

a^1. Fronds uniform.
  b^1. Pedicel and stipe together under 1 cm long.
    c^1. Sori subcostal to medial.
      d^1. Indusium conspicuous..... 1. *O. neriiformis.*
      d^2. Indusium small and fugacious..... 2. *O. Archboldii.*
    c^2. Sori submarginal..... 3. *O. Archboldii.*
  b^2. Fronds longer-stalked.
    c^1. Pedicel and stipe more or less equal..... 4. *O. Sibbaldii.*
    c^2. Pedicel long, stipe short.
      d^1. Pedicel 2 mm thick, scaly..... 5. *O. crassipes.*
      d^2. Pedicel 1 mm thick, naked..... 6. *O. gracilis.*
a^2. Fronds dimorphous..... 7. *O. Werneri.*

1. OLEANDRA NERIIFORMIS Cavanilles.

In Supplement III (1934) of his Index Christensen includes *O. colubrina* (Blanco) Copel. in this species, but excludes *O. pistillaris* (Sw.) C. Chr., the last possibly including *O. hirtella* (Miq.) Kunze. I suppose that this is correct, but still do not know what it means. *O. colubrina* var. *membranacea* has been reported from New Guinea (Brause). *"O. neriiformis* var. *mollis* (Pr.)", *Ros. Fil. novog. exsic. No. 132, 1. Werner*, is not *O. mollis* Presl, but I am not ready to give it another name. It has a very short pedicel and a well-developed stipe, and the persistent indusia common in the genus.

2. OLEANDRA CUSPIDATA Baker.

Oleandra cuspidata BAKER, Malesia 3 (1886) 44.

I construe this species by *Carr 13428*, identified by Alston. The same species is represented by *Brass 12842, 13215*, and *13323*. I cannot see that these are distinct from *Schlechter 18572* and *19626*, received as *O. hirtella*, evidently identified by Brause. The latter have the short pedicel and obsolete stipe of *O. colubrina*, but there is one conspicuous difference,—the indusium is minute and fugitive, not to be detected on most specimens in the herbarium. The same fern occurs in Java, and may well be *O. hirtella*, which I do not otherwise know. If these specimens are all correctly named, they are *O. hirtella*, and *O. cuspidata* is a synonym.

3. OLEANDRA ARCHBOLDII Copeland sp. nov. Plate 1.

Caudice suffruticoso-scandente, 4 mm crasso, lignoso, apice excepta relictis nigris palearum protecto, apice palearum caudis fulvo-fuscis squarrosis pilis albis ciliatis ornato; phyllopodiis laxe verticillatis, 2 mm longis; frondibus sessilibus, 12 ad 15 cm longis, 10 ad 13 mm latis, caudato-acuminatis, basi acutis vel obtusis, coriaceis, costa venisque inferne decidue albo-setosis, superne olivaceo-fuscis, inferne pallescentibus; soris submarginalibus, parvis, indusiis plerisque hippocrepiformibus.

DUTCH NEW GUINEA, 6 kilometers southwest of Bernhard Camp, Idenburg River, altitude 1450 meters, *Brass No. 13002*. "Scandent in rain forest, epiphytic high on large trees."

A relative of *O. hirtella* Miq., well distinguished from that and other species by the small fronds and submarginal sori.

4. OLEANDRA SIBBALDII Greville.

Brass No. 11266, 18 kilometers northeast of Lake Habbema, altitude 2200 meters, "fronds very thin and soft;" *No. 12158*,

16 kilometers southwest of Bernhard Camp, Idenburg River, altitude 1800 meters, not nearly so thin and with darker pubescence.

Construing this as I do for the present, including *O. Whitmeei* and probably *O. Cumingii*, it is a variable and comprehensive species, but still may not well include the following species.

5. OLEANDRA CRASSIPES Copeland sp. nov. Plate 2.

Rhizomate scandente, 3 mm crasso, paleis ferrugineis brunnescentibus lanceolatis attenuato-acuminatis usque ad 5 mm longis basi peltatis vestito; phyllopodiis inter se ca. 1 cm remotis, 2 ad 3 cm longis, 2 mm crassis, piluliferis et paleaceis deinde asperulis; stipite 2 ad 5 mm longo; lamina 15 ad 20 cm longa, 22 ad 27 mm lata, caudata caude 1 ad 1.5 cm longa, basi acuta, subcoriacea, ubique puberula, inconspicue ciliata, costa paleis 2 ad 3 mm longis recte distantibus ornata; soris irregulariter inframedialibus, indusio glabro fere orbiculare.

DUTCH NEW GUINEA, *Brass No. 12109*, 15 kilometers southwest of Bernhard Camp, Idenburg River, altitude 1800 meters; "plentiful as a root-climbing epiphyte in the mossy forest."

A relative of *O. Sibbaldii*, smaller and more firm in texture; distinct in form from *O. gracilis*, which it resembles in the long phyllopodium and the short stipe, unlike both of the preceding species in its very stout stalk.

6. OLEANDRA GRACILIS Copeland.

Oleandra gracilis COPELAND, Univ. Calif. Publ. Bot. 12 (1931) *pl. 52b.*

Bolan. *Keysser 74* (?); known by the one collection.

7. OLEANDRA WERNERI Rosenstock.

Brass 11870, 12841, 13214, altitude 850 to 1800 meters. Previous collections are *Werner 12*, the type, from Mount Gelu, altitude 1000 meters; *Schlechter 16689*, altitude 300 meters; *Carr 13981*, Lala river, altitude 1700 meters. The degree of dimorphism is variable, even in the type collection. *O. dimorpha* Copel., Solomon Islands, is distinguished from the present species by conspicuous hairiness.

Genus DAVALLODES Copeland

Key to the New Guinea species of Davallodes.

a^1. Indusium wider than long, sides free..... 1. *D. novoguineense.*
a^2. Indusium elongate, sides attached..... 2. *D. dolichosorum.*

1. DAVALLODES NOVOGUINEENSE (Ros.) Copeland.

Davallodes novoguineense (Ros.) COPELAND, Univ. Calif. Publ. Bot. 12 (1931) 400.

Brass 11417, Bele river, altitude 2200 meters. Previous collections are *Keysser*, the type, and *Carr 11507*.

2. DAVALLODES DOLICHOSORUM Copeland.

Davallodes dolichosorum COPELAND, Philip. Journ. Sci. 34 (1927) 248.

Known only by the type collection, *Schlechter 17857*, Mount Kani, altitude 600 meters.

Genus LEUCOSTEGIA Presl

LEUCOSTEGIA PALLIDA (Mett.) Copeland.

Leucostegia pallida (Mett.) COPELAND, Philip. Journ. Sci. 34 (1937) 252.

Brass 13295, in Agathis forest, altitude 850 meters. Throughout New Guinea.

Unknown to me are:

Leucostegia laxascaphides (Baker) C. CHRISTENSEN, suppl. III (1934) 120.

Leucostegia subdigitata (Brause) C. CHRISTENSEN, suppl. III (1934) 121.

Davallia Farbesii CARRUTHERS in Gepp, Journ. Bot. 61 (1923) suppl. 59.

All of these, Christensen suggests, may be one species.

Genus HUMATA Cavanilles

This is the largest and most difficult genus of its group. Typically epiphytes, the individuals are subject to wide variations in exposure, and some of them are very responsive to these differences. Independent of the environment, some species seem to be notably variable. Thus Cavanilles described two species from Guam. The common judgment has been that they are forms of one species, but Christensen now regards them as distinct; if they are so, I have a third, but I have no present opinion as to whether they are one or three.

In another group of species Smith combined a Malayan and a Tahitian plant in describing (*Davallia*) *H. pectinata*. *H. parallela* (Wall.) Brack. and *H. gaimardiana* (Gaud.) J. Sm. were subsequently described in the same group. With many specimens from the Society Islands, it seemed to me that each island had its own more or less distinct form, none of these like the comparatively uniform Malayan plant. It occurred to me that the Malayan plant might be the real *H. pectinata*, so I invited comparison of types by Mr. Alston. The result was his finding the Tahiti specimens to be of two species, *H. pectinata* and *H.*

Banksii.[1] It is my conclusion, not his, that the Malayan plant must be *H. parallela,* for I have no Malayan specimen duplicated by any from Tahiti.

Some characters which usually serve as specifically diagnostic, serve so badly in *Humata.* Size varies greatly as a matter of plasticity (response to environment). So, with size, does the dissection of the frond; and so probably do texture and laxness. Paleæ are likely to be deciduous. And dimorphism is subject to some reversion, aside from the fact that degrees of dimorphism are hard to describe.

In the light of the foregoing discussion it will be understood that considerable work on this genus leaves me ill satisfied. The presentation here given is the best I can make with the present material.

Key to New Guinea species of Humata.

a^1. No fronds more than once-pinnate or pinnatifid.
  b^1. Dimorphous, sterile fronds simple..... 1. *H. heterophylla.*
  b^2. Fronds uniform.
    c^1. Middle segments entire or nearly so.
      d^1. Veins thick, indusia deep..... 2. *H. parallela.*
      d^2. Veins slender, indusia short and wide..... 3. *H. tenuivenia.*
    c^2. Middle segments coarsely toothed.
      d^1. Lowest segments reduced..... 4. *H. Archboldii.*
      d^2. Lowest segments not reduced..... 5. *H. sessilifolia.*
a^2. Fertile, not sterile, fronds bipinnatifid..... 6. *H. dimorpha.*
a^3. All fronds at least bipinnatifid, deltoid.
  b^1. Fronds up to 5 cm long, fertile segments to 1 mm broad.
    c^1. Stipes naked.
      d^1. Sterile segments up to 1 mm wide.
        e^1. Fertile fronds more dissected than sterile.... 7. *H. crassifrons.*
        e^2. Fronds not dimorphous..... 8. *H. parvula.*
      d^2. Sterile fronds less finely dissected..... 9. *H. pusilla.*
    c^2. Stipes scaly..... 10. *H. Brassii.*
  b^2. Fronds larger or less finely dissected.
    c^1. Fronds 4 to 8 cm long, sterile, hardly bipinnatifid above base.
      d^1. Fronds not or slightly dimorphous..... 11. *H. repens.*
      d^2. Fertile fronds contracted and more dissected. 12. *H. kinabaluensis.*
    c^2. Fronds larger and more compound.
      d^1. Axes bearing peltate-acicular paleæ.
        e^1. Stipe 1 to 3 cm long..... 13. *H. deltoidea.*
        e^2. Stipe much longer..... 14. *H. tenuis.*
      d^2. Paleæ plane or wanting.
        e^1. Medial sterile pinnæ subentire.

[1] Philip Journ. Sci. 50 (1933) 175.

f^1. Sterile frond lax.
g^1. Frond naked..... 15. *H. neoguineensis.*
g^2. Axes more or less scaly.
h^1. Paleæ of frond minute..... 16. *H. Werneri.*
h^2. Paleæ of frond conspicuous..... 17. *H. vestita.*
f^2. Sterile pinnæ and segments contiguous....18. *H. cromwelliana.*
e^2. Medial sterile pinnæ at least incised.
f^1. Sori conspicuously intramarginal..... 19. *H. introrsa.*
f^2. Indusium reaching margin.
g^1. Axes or segments nowhere 1 mm wide....20. *H. mecodioides.*
g^2. Less finely dissected..... 21. *H. similis.*

1. HUMATA HETEROPHYLLA (Sm.) Desvaux.

Brass 13984, Idenburg River, altitude 50 meters. Throughout New Guinea, collected repeatedly.

2. HUMATA PARALLELA (Wall.) Brackenridge.

Reported several times; I have it from Copland King, from the East end of the island.

3. HUMATA TENUIVENIA Copeland sp. nov. Plate 3.

Humata pectinatæ affinis, venis tenuibus inconspicuis, soris perlatis curvis, indusiis brevibus distincta.

DUTCH NEW GUINEA, Bernhard Camp, Idenburg River, altitude 50 meters, *Brass No. 14082,* "low epiphyte in flooded forest."

The sori are so widened around the ends of the veins that the indusium at one side directly faces the margin, which it does not quite reach, and at the other side faces the apex of the segment, or in extreme cases is curved so far that it faces an angle to the costa. The longer segments bear about 25 pairs of sori, but the spaces between them are usually wider than the indusia are long.

4. HUMATA ARCHBOLDII Copeland sp. nov. Plate 4.

Humata pectinato-pinnatifida segmentis egregie serratis; rhizomate 2 mm crasso, paleis 6 mm longis lanceolatis ferrugineis, plus minusve patentibus immerso; stipite 6 ad 11 cm alto, fusco, paleis sparsis setaceis 3 mm longis patentibus basibus peltatis interdum binatis ornato; lamina 15 ad 18 cm longa, 3.5 ad 5 cm lata, acuminata, ad alam 1 ad 2 mm latam pinnatifida, fusca, chartacea, costa setaceo-paleacea, segmentis 5 mm latis, serratis mucronatis, inferioribus brevioribus rotundatis; soris in axillis dentium solitariis, parvis, indusio cum margine conterminante.

DUTCH NEW GUINEA, 4 kilometers southwest of Bernhard Camp, Idenburg River, altitude 900 meters. *Brass No. 13301;* "frequent on mossy surface-roots in Agathis forest."

A most distinct species, related to *H. sessilifolia.*

5. HUMATA SESSILIFOLIA (Blum.) Mettenius.

KAISER-WILHELMSLAND, *Schlechter 18693, Keysser 231.*

6. HUMATA DIMORPHA Copeland.

Brass 13625, Idenburg River, altitude 850 meters; smaller and less dissected than the type, *1. Copland King.* I am unable to distinguish *H. Ledermanni* Brause.[2]

7. HUMATA CRASSIFRONS van Alderwerelt van Rosenburgh.

Humata crassifrons VAN ALDERWERELT VAN ROSENBURGH, Bull. Jard. Buit. II 7 (1912) 18.

The type of this species is *Schlechter 14430,* from Mount Torricelli, which I have not seen. It is cited by Brause[3] as *H. Schlechteri,* published the same month. I suppose that it should be reduced to *H. pusilla.*

8. HUMATA PARVULA (Wall.) Mettenius.

Bamler 32 (1912); *Brass 694,* Gawasari, altitude 1200 feet. The latter is an excellent match for Wallich's type collection.

9. HUMATA PUSILLA (Mett.) Carr.

Humata perpusilla VAN ALDERWERELT VAN ROSENBURGH, Bull. Jard. Buit. II 7 (1912) 17.

Humata subtilis VAN ALDERWERELT VAN ROSENBURGH, Bull. Jard. Buit. II 7 (1912) 17.

Humata Schlechteri BRAUSE, Bot. Jahrb. 49 (1912) 26.

Brass 8906, 13849, apparently common throughout New Guinea.

Van Alderwerelt v. Rosenburgh[4] himself reduced *H. perpusilla* to *H. subtilis.* Both are reduced to *H. pusilla* by Christensen,[5] correctly in my opinion. *H. Schlechteri,* typified by *Schlechter 16493,* is within the range of *H. pusilla* in New Caledonia; and I can in no respect distinguish *Schlechter 16382,* received with Brause's identification as *H. pusilla.*

10. HUMATA BRASSII Copeland sp. nov. Plate 5.

H. parva anguste dissecta soris cornubus vix superatis. Rhizomate 1.5 mm crasso, paleis ferrugineis squarrosis 3 ad 4 mm longis lanceolatis vestito; frondibus fere uniformibus, stipite 2 ad 5 cm alto gracile, rhachique paleis planis ferrugineis fuscescentibus 1.5 mm longis deciduis vestitis; lamina ca. 4 cm longa,

[2] Bot. Jahrb. 56 (1920) 120.
[3] Bot. Jahrb. 49 (1912) 27.
[4] Suppl. I (1917) 218.
[5] Suppl. III (1934) 112.

2.5 cm lata, acuta, subdeltoidea, basi tripinnata, rhachibus anguste alatis marginibus modo incrassatis elevatis, segmentis (pinnulis) usque ad 2 mm longis 0.5 mm latis; soris plerisque ad segmenta lateralibus apicibus segmentorum plus minusve superatis, indusio parvo vario, saepius quam alto latiore, cum margine conterminante.

DUTCH NEW GUINEA, 11 kilometers northeast of Wilhelmina top, altitude 3400 meters, *Brass & Myer-Dress No. 9678*, epiphytic on tree fern; also, Lake Habbema, altitude 3,225 meters, *Brass No. 11849*, "common in ground moss of open thickest and isolated tree clumps," somewhat smaller than type; also *Brass No. 9097*, same locality, "plentiful as an epiphyte in open mossy thickets." The last collection is the most scaly, but otherwise suggests *H. pusilla*.

11. HUMATA REPENS (Linn. f.) Diels.

This is an exceedingly plastic species, which I am still disposed to construe as including *H. alpina* (Blume) Moore; at any rate, what seems to be one species in Luzon includes forms referable to both. From New Guinea I have *Horner 176,—H. repens v. minor* Ros.—a very depauperate form; and *Bamler, Ros., Fil. Novog. Exisc. No. 145*, received as *H. alpina* var. *edentula* Ros., which may not really be this species at all.

12. HUMATA KINABALUENSIS Copeland.

Brass 10519, 10645, 11866, 12924, altitude 1200 to 2860 meters Already reported from New Guinea by Christensen.[6]

13. HUMATA DELTOIDEA Copeland sp. nov. Plate 6.

H. mediocris deltoidea pinnulis serratis stipite breve. Rhizomate 3 mm crasso, paleis brunneis lanceolatis 3 ad 4 mm longis plus minusve patentibus vestito; frondis sterilis stipite ca. 1 cm longo, rhachique paleis parvis basi peltatis saepe stellatoramiferis, axe aciculare nigro-fusca patente ciliata sparsis ornatis, lamina 5 ad 6 cm longa fere aequilata, acuta, basi tripinnatisecta, pinnulis medialibus inciso-serratis contiguis 2 ad 3 mm latis 4 ad 6 mm longis papyraceis; frondis fertilis stipite 3.5 cm longo, lamina 8 cm longa, 7 cm lata, acuminata, pinnulis modo contractis, soris in sinubus dentium aut cornutorum aut obsolescentium parvis, indusiis quam altis latioribus plerisque extra marginem rotundatis.

[6] Brittonia 2 (1937) 287.

DUTCH NEW GUINEA, 4 kilometers southwest of Bernhard Camp, Idenburg River, altitude 850 meters. *Brass No. 13382*, "common epiphyte in the rain forest."

The paleæ of stipe and rachis are similar to those of *H. tenuis* and *H. Archboldii*, but there is little other evidence of near affinity.

14. HUMATA TENUIS Copeland.

Brass Nos. 8939, 13849, altitude 175 to 375 meters. First collected by Copland King, then by Brass on the Uumi river in 1926. Here belongs also *Bamler 30 R*, distributed as *H. alpina*.

15. HUMATA NEOGUINEENSIS C. Christ.

Davallia (*Humata*) *bipinnatifida* BAKER, Kew Bull. (1899), *non* Blume.

"Speciebus reliquis hujus subgeneris recedit frondibus lanceolato-deltoideis bipinnatifidis."—Baker. Stipe 3 to 4 inches long, naked, lamina 5 to 6 inches long, 2 inches wide, naked, fertile pinnæ narrower and more deeply cut than the sterile. Shape, size, nakedness, and limited dissection should identify this species, but I do not know it. In Herb. Univ. Calif. are Schlechter *19006* and *19261*, so named; the larger fronds are 5 cm long, 3.5 cm broad,—very discrepant in shape as well as in size from Baker's description. They are naked, which is unusual in deltoid *Humata*. Both sterile and fertile fronds are dissected to axes less than 1 mm wide, including the exceedingly narrow wings. I mistrust the identification.

16. HUMATA WERNERI Copeland.

Brass 11618, 12792, altitude 1200 and 1860 meters. The original, from Gelu, is not at hand, but these seem to be the same species.

17. HUMATA VESTITA (Blume) Moore.

A form not quite identical with the typical, reported by v. Alderwerelt v. Rosenburgh,[7] near Doorman river.

18. HUMATA CROMWELLIANA Rosenstock. Plate 7.

Described from *Bamler K. 8*, Cromwellgebirge, and not again collected. It is a species well marked by its very compact, coriaceous fronds.

[7] Malesia 14 (1924) 26. *Lam 1246*.

19. HUMATA INTRORSA Christ.

Humata introrsa CHRIST, Nova Guinea **8** (1909) 160.

Said to be near *H. vestita*, but less scaly. Christ emphasized the remoteness of the sori from the margin.

20. HUMATA MECODIOIDES Copeland sp. nov. Plate 8.

H. decomposita vix dimorpha, rhizomate 2 mm crasso, primo paleis fuscis 2 mm longis plus minusve patentibus vestito, vetustate rugoso, glauco, palearum basibus peltatis nigro-fuscis sparso; frondium sterilium stipitibus usque ad 7 cm longis, rhachibusque paleis ferrugineis lanceolatis ciliatis 1 mm longis deciduis sparsis, lamina subdeltoidea, 6 ad 8 cm longa, 4 ad 5 cm lata, basi tripinnatisecta pinnulis secundariis infimis aut integris aut pinnatifidis, papyracea, rhachibus alatis vix 1 mm latis, segmentis 0.5 mm latis; fronde fertile paulo longius stipitata, 11 cm longa, 8 cm lata, axibus tantum marginatis, soro in sinu dentis obtusi brevis quisquis imposito, indusio plerumque late reniforme margini aequante.

DUTCH NEW GUINEA, Balim River, altitude 1600 meters. *Brass No. 11691*, "forming a patched low ground cover in Castanopsis primary forest."

The most finely dissected species with fronds of considerable size.

21. HUMATA SIMILIS Copeland sp. nov. Plate 9.

H. tripinnatifida vix dimorpha, rhizomate 2 mm crasso paleis sordide fuscis 1 ad 2 mm longis lanceolatis appressis sparso, demum dejectis paleis fusco; stipite 7 ad 11 cm alto, gracile, rhachique paleis ovatis pellatis acuminatis caducis ornatis mox glabratis; lamina 11 cm longa, 7 ad 9 cm lata, breviacuminata, papyracea, tripinnatifida, rhachibus angustissime alatis, segmentis 0.8 ad 1.5 mm latis; soris in parte superiore frondis aut ad latera segmentorum solitariis aut in sinubus dentium brevium vel obsolescentium, indusio saepius semiorbiculare margini plus minusve aequante.

DUTCH NEW GUINEA, 4 kilometers southwest of Bernhard Camp, Idenburg River, altitude 850 meters, *Brass No. 13365*, "plentiful on mossy rocks in a rain forest ravine."

The specimen consists of two fronds, one more finely dissected than the other, both fertile towards the apex and sterile below, and the fertile part inconspicuously contracted, both all but naked. It may be suspected that they do not represent the species in full fruit.

Genus DAVALLIA Smith

Key to the New Guinea species of Davallia.

a^1. Fronds pubescent, dimorphous..... 1. *D. Pullei.*
a^2. Frons naked.
  b^1. False veins present between true veins.
    c^1. Indusium reaching margin..... 2. *D. denticulata.*
    c^2. Indusium intramarginal..... 3. *D. papuana.*
  b^2. False veins wanting.
    c^1. Indusium free except toward base..... 4. *D. epiphylla.*
    c^2. Sides of indusium attached throughout.
      d^1. Indusium hardly longer than broad.
        e^1. Fronds over 50 cm long.
          f^1. Apex of indusium truncate..... 5. *D. divaricata.*
          f^2. Apex of indusium rounded..... 6. *D. tenuisecta.*
        e^2. Fronds smaller..... 7. *D. pyxidata.*
      d^2. Indusium twice as long as broad.
        e^1. Paleæ naked, hardly spreading..... 8. *D. solida.*
        e^2. Paleæ ciliate, spreading..... 9. *D. trichomanoides.*

1. DAVALLIA PULLEI Rosenstock.

Davallia Pullei ROSENSTOCK, Nova Guinea 8 (1912) 719.

DUTCH NEW GUINEA, along streams at sea level, *von Roemer 214*. Not again reported. Very aberrant in the genus.

2. DAVALLIA DENTICULATA (Burm.) Mettenius.

Collected by Bamler and Ledermann in Germany, and by von Roemer in Dutch New Guinea.

3. DAVALLIA PAPUANA Copeland.

Davallia papuana COPELAND, Philip. Journ. Sci. § C 6 (1911) 81.

Type by Copland King, from "Papua;" not again reported.

4. DAVALLIA EPIPHYLLA (Forster) Spr.

Brass 13839, altitude 150. *Bamler 7*, from Rook Island, is the same.

5. DAVALLIA DIVARICATA Blume.

Collected by Ledermann and by Carr.

6. DAVALLIA TENUISECTA Copeland sp. nov. Plate 10.

D. corniculatae affinis magis dissecta, rhizomate scandente, 8 mm crasso, paleis cimmamomeis linearibus apice acicularibus sparse ciliatis 7 mm longis immerso; stipite 35 cm alto, gracile, nudo, brunneo; fronde 60 cm longa, late ovata, glabra, tenuiter papyracea, 4 vel 5-pinnatifida; pinnis infimis 30 cm longis, 20 cm latis, acuminatis, longe (3 cm) pedicellatis; pinnulis ovatis, primariis caudato-acuminatis pedicellatis, secundariis acutis vel acuminatis rhachibus anguste alatis, tertiariis majoribus ovatis acutis pinnatisectis, ultimis incisis; venulis tenuibus; soris late-

ralibus exteriore, terminalibus utroque latere conspicue cornutis, impressis, indusio aut ad marginem attingente aut paulo retracto, ca. 0.7 mm longo, 0.5 mm lato, breve libero rotundato.

DUTCH NEW GUINEA, Balim River, altitude 1600 meters, *Brass No. 11701.* "Occasional epiphyte in *Castanopsis* forest."

7. DAVALLIA PYXIDATA Cavanilles.

Reported from neighboring islands, not from New Guinea itself.

8. DAVALLIA SOLIDA (Forster) Swartz.

Repeatedly collected.

9. DAVALLIA TRICHOMANOIDES Blume.

Brass 11692, 12793, 13043, altitude 1200 to 1600 meters, Sattelberg, German New Guinea, *Keysser 8, 233.*

Genus SCYPHULARIA Fee

Key to the New Guinea species of Scyphularia.

a^1. Margin entire or sori on teeth..... 1. *S. pentaphylla.*
a^2. Sori between teeth.
  b^1. Indusium about reaching margin..... 2. *S. sinusora.*
  b^2. Indusium remote from margin..... 3. *S. dorsalis.*

1. SCYPHULARIA PENTAPHYLLA (Blume) Fee.

Reported from New Guinea, but perhaps because of imperfect discrimination of species.

2. SCYPHULARIA SINUSORA Copeland.

Known only by the type collection, *King 183,* from Goodenough Bay.

3. SCYPHULARIA DORSALIS Copeland.

Scyphularia dorsalis COPELAND, Univ. Calif. Publ. Bot. 12 (1931) 401, *pl. 54a.*

Known only by the type collection, *Bamler 34,* from Sattelberg.

Genus ARTHROPTERIS J. Smith

ARTHROPTERIS KINGII Copeland.

Arthropteris dolichopoda VAN ALDERWERELT VAN ROSENBURGH.

Brass No. 13052, Idenburg River, altitude 650 meters.

A. dolichopoda is a better developed plant than is the type of *A. Kingii,* but is almost surely the same species. Brass's plant is still better developed, apparently representing the same species in its perfect form, fronds up to 35 cm long, pinnæ deeply inciso-serrate and strongly auricled. It is near *A. articulata,* and thus to *A. orientalis,* which, as represented here, have pinnæ scarcely auricled, and the lowest ones hardly deflexed.

ILLUSTRATIONS

[Photographs by W. C. Mathews.]

PLATE 1. *Oleandra Archboldii* Copeland sp. nov.; type.
2. *Oleandra crassipes* Copeland sp. nov.; type.
3. *Humata tenuivenia* Copeland sp. nov.; type.
4. *Humata Archboldii* Copeland sp. nov.; type. *a*, habit; *b*, paleæ, × 10.
5. *Humata Brassii* Copeland sp. nov.; type.
6. *Humata deltoidea* Copeland sp. nov.; type.
7. *Humata cromwelliana* Ros.; cotype.
8. *Humata mecodioides* Copeland sp. nov.; type.
9. *Humata similis* Copeland sp. nov.; type.
10. *Davallia tenuisecta* Copeland sp. nov.; type.

PLATE 1. OLEANDRA ARCHBOLDII COPELAND SP. NOV.

PLATE 2. OLEANDRA CRASSIPES COPELAND SP. NOV.

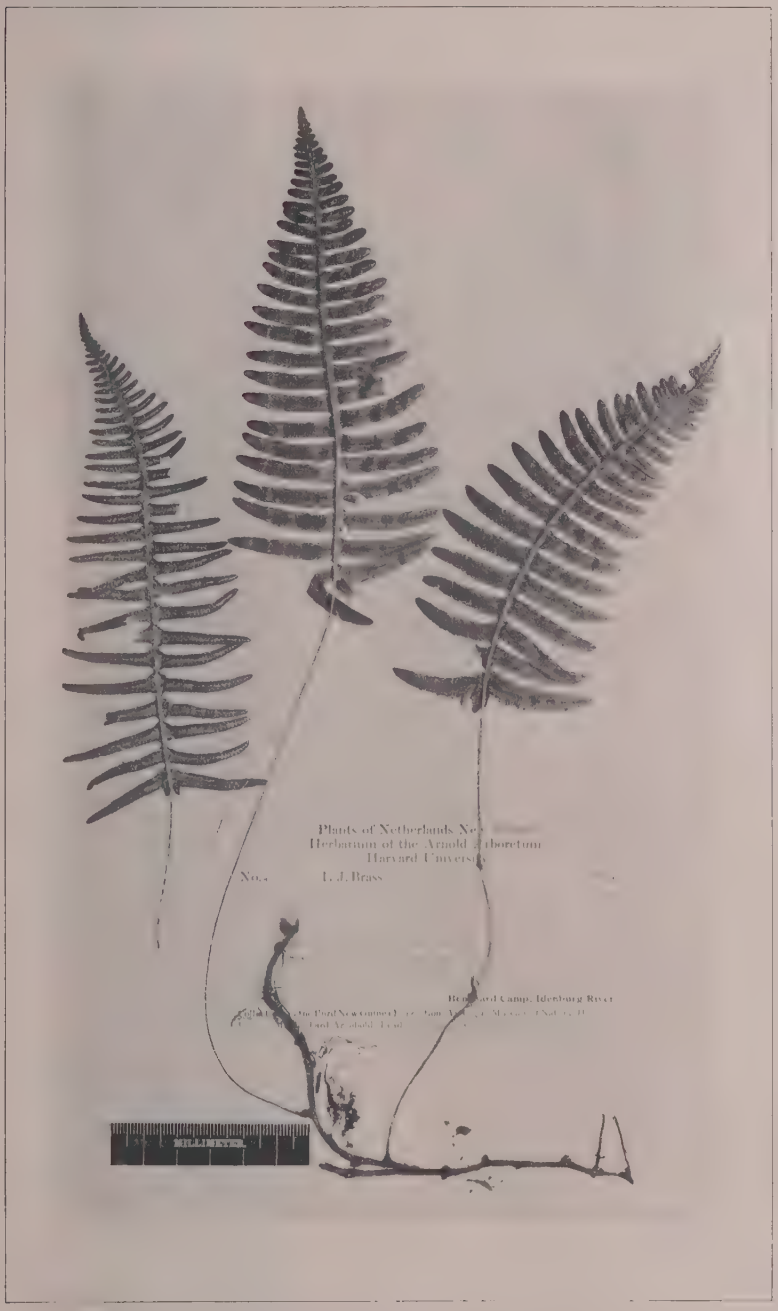

PLATE 3. HUMATA TENUIVENIA COPELAND SP. NOV.

PLATE 4. HUMATA ARCHBOLDII COPELAND SP. NOV.

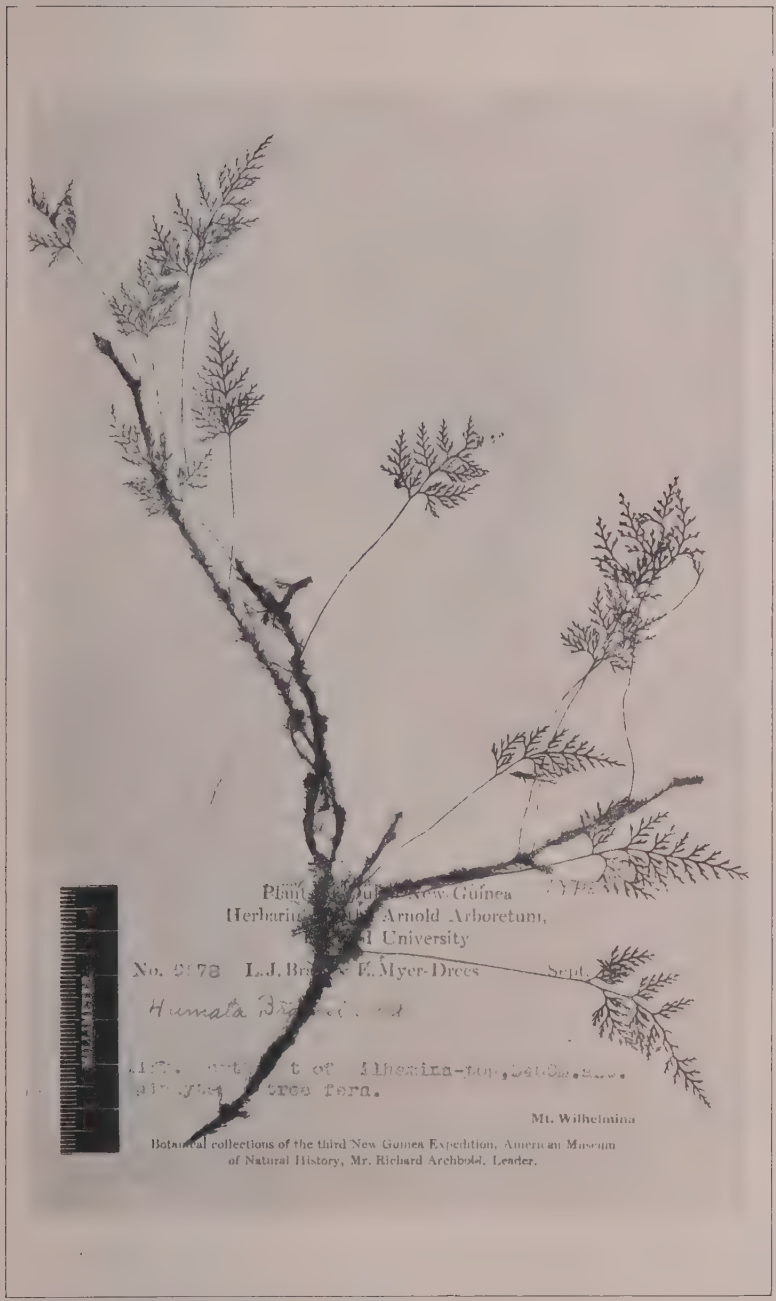

PLATE 5. HUMATA BRASSII COPELAND SP. NOV.

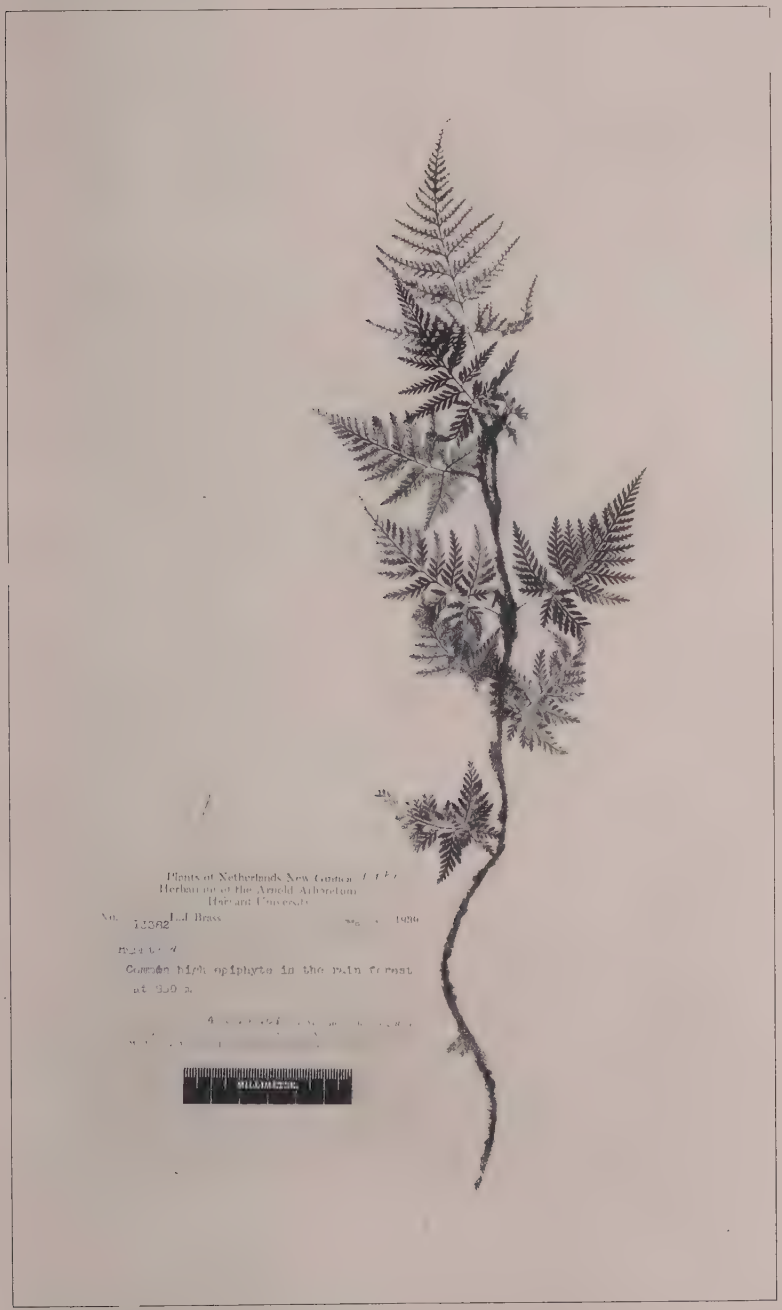

PLATE 6. HUMATA DELTOIDEA COPELAND SP. NOV.

PLATE 7. HUMATA CROMWELLIANA ROS.

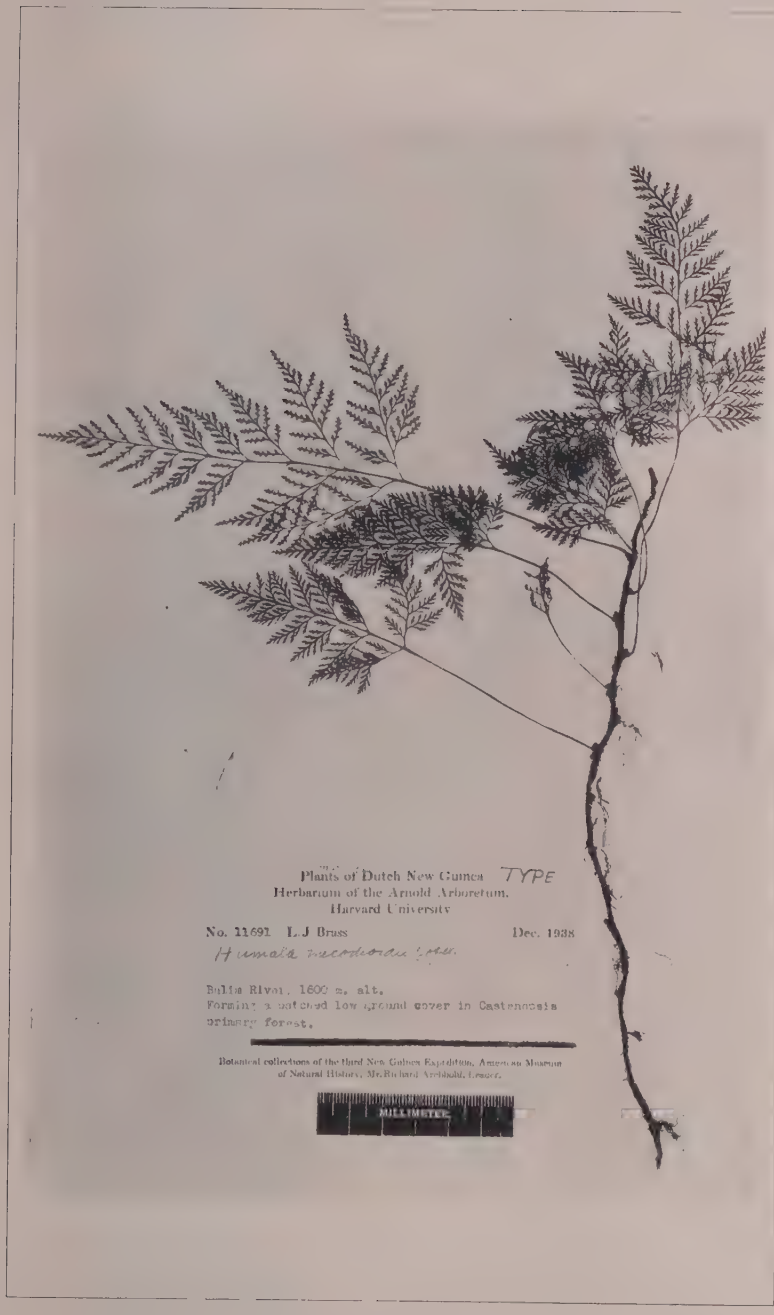

PLATE 8. HUMATA MECODIOIDES COPELAND SP. NOV.

PLATE 9. HUMATA SIMILIS COPELAND SP. NOV.

PLATE 10. DAVALLIA TENUISECTA COPELAND SP. NOV.

BOOKS

Books reviewed here have been selected from books received by the Philippine Journal of Science from time to time and acknowledged in this section.

REVIEWS

A. S. T. M. Standards on Textile Materials. Prepared by Committee D–13 on Textile Materials. Specifications, Tolerances, Methods of Testing, Definitions and Terms. Published by the American Society of Testing Materials. Philadelphia, October, 1938. 323 pp., illus. Price, $2.

This pamphlet contains the thirty standard and twenty tentative standard specifications for textile and related materials that have been promulgated by the American Society for Testing Materials Committee D–13 on Textile Materials. Among other things, it contains the standard methods for testing, tolerances of, and specifications for cotton, silk, wool, jute, rayon, and asbestos yarns and fabrics; definitions of and terms relating to textile materials; identification of fibers, specifications for testing machines, and methods for testing the fastness of colored fabrics. A comprehensive appendix gives photomicrographs of common textile fibers, a yarn number conversion table, a psychrometric table for relative humidity, a glossary of terms relating to textile materials, and several proposed methods of tests not yet acted upon by the Society. A symposium on testing methods and one on textile finishes by leading authorities on the subjects are given at the end of the pamphlet. All in all this pamphlet contains a complete compilation of data which should prove of great value to anybody interested in textile materials, whether they be manufacturers, consumers, or research workers.—Q. O.

1938 Supplement to Book of A. S. T. M. Standards. Philadelphia, American Society for testing materials, 1938. 241 pp., illus.

This supplement contains 57 standards adopted or revised by the American Society for Testing Materials by letter ballot, September 1, 1938. Thirty-two of these are new, being the revised and amended forms of the tentative standards issued in previous years. The rest are existing standards to which amendments have been introduced.

Some of the specifications do not differ very much from those they supersede. In some instances the changes are in the form of further explanations or details, a reorganization of the procedures of tests, or a clearer definition of the scopes covered by the standards. However, there are quite a number in which changes of importance are made. A few of these changes are the lowering of the maximum limit for the carbon content of carbon-silicon steel, the increased rigidity requirement for class A steel plates, the modification of the requirement for fineness of Portland cement and the recognition of 1 per cent admixture, the acceptance of southern yellow pine and two species of white pine as standard wood for panels in paint and varnish tests, and the modification of the specifications for white lead.

A new test called "Powdered Pourability," used in testing molding powders, is introduced.

This supplement is a valuable addition to the increasing collection of books on standards issued by the American Society for Testing Materials. It is recommended to all who are engaged or interested in modern methods of testing materials.

—J. M.

Standard Methods of Analysis of Iron, Steel, and Ferro-Alloys. Rev. & enl. ed. Published by the United Steel Companies, Lt., 1936. 81 pp. Price, 4s/6d.

This revised and enlarged edition of a book first published in 1933 contains selected analytical methods which have been adopted as standard procedures in the laboratories of the various companies composing the United Steel Companies Limited, England, for the analysis of every grade of iron, steel, and ferro-alloys. Fourteen new methods are included, in addition to the modifications made in some methods in order to avoid the effects of interfering elements. The book lives up to its title and leaves little to criticize. The directions are clear and any one reasonably familiar with analytical technique can easily follow them.

Recommended with confidence by one of the great steel companies of the world, this volume should be a welcome addition to a chemist's library and should prove indispensable to those engaged in the analysis of iron and its alloys.—B. R. S.

The Chemists' Year Book, 1939. Founded by F. W. Atack. Edited by E. Hope Sherratt and Hughes. St. Ann's Press, Timperley and Manchester, England.

The professional chemist, in his daily activities, is confronted with varied problems of technical nature. He may be called upon to outline chemical processes, to prepare specifications or estimates, to operate industrial plants in which chemical problems are involved, to supervise testing and general analytical laboratory work, or to do many other things in connection with chemistry and physics. He is expected to solve these problems quickly and accurately because modern industrial practice so requires. With this end in view, the consolidation of the formulas and constants for which he is accustomed to search through several text books, would be much desired. In "The Chemists' Year Book", all the physicochemical constants, condensed methods of analytical procedures, and conversion, logarithmic, and trigonometric tables are presented in a systematic order and in a convenient form to fit the pocket. In my opinion this book is very valuable not only to the professional chemist but also to the student of chemistry and physics.

Certain sections of the 1938 edition have been revised and brought up to date; so that the 1939 edition may be considered a revised and improved edition.—R. H. A.

Photographic Chemicals and Solutions. By J. I. Crabtree and G. E. Matthews. Boston, American photographic publishing Co., 1938. 360 pp., illus. Price, $4.

The authors state in the preface that this book represents some of the knowledge acquired during the past twenty-five years in compounding photographic solutions and studying their application to photography in the research laboratories of the Eastman Kodak Company. In preparing this book the requirements of the small as well as the large users of photographic chemicals were kept in mind. The book should therefore be of value to all classes of photographers, including amateurs, professionals, scientific investigators, x-ray, photo finishing, photomechanical, and motion-picture workers.

Some of the topics especially discussed are, photographic apparatus and methods of use; technique of mixing, using, storage, and transportation of photographic solutions; stains on negatives, prints, hands, and clothing.

This book will no doubt be very helpful especially to amateur photographers who wish to make their own solutions and do their own photographic work.—A. P. W.

Paints and Painting. A Manual on the Composition of Paints and Specifications for Their Use. By G. C. Molleson. Philadelphia, David McKay Co., 1939. 274 pp., illus., front. Price $2.

This book is a manual of information on the compositions and specifications of the great and ever-increasing number of paint materials actually available in the market today. The author appears to have written the book with special reference to the adaptability of these materials.

The book begins with a discussion on the properties of paint films, the pigments, and the vehicle of which paints are composed. The middle portion of the book (Chapters 2 to 4) is an enumeration of the various kinds of paint materials—paints, varnishes, lacquers, and the like—with a brief description of their compositions, methods of manufacture, specifications under which paints may be bought, trade names under which the different types of paints are sold in the market, and also adulterants which are likely be found in them. There is also included a discussion on especial kinds of paints; such as, for example, stucco and concrete paints, anti-fouling paints, automobile enamels, and others. The last part of the book gives the general methods of painting and varnishing, together with some examples of cost estimating. A great number of examples of paint compositions that may be used efficiently for the different painting jobs, is also included. The book ends with a chapter on terms and definitions which are commonly used in paint technology and an understanding of which is necessary to a clear idea of paint specifications.

As a whole, the book will serve not only as a helpful source of information for paint chemists, but also as a valuable, practical, and up-to-date guide to technical men and others who are interested in or responsible for the maintenance and preservation of buildings, bridges, equipment, and other miscellaneous structures.—E. R.

Pottery Made Easy. By John Wolfe Dougherty. Milwaukee, The Bruce publishing Co., 1939. 179 pp., illus., front. Price, $2.25.

The author, because of his many years of experience in teaching ceramics, ably presents, in a clear, simple, and intelligible manner, the different steps in making pottery ware. Pictures and diagrams profusely illustrate his present book, so that any

one may easily follow the operations of a potter. The book covers the following chapters: Pottery—An Interesting Craft, Pottery and Its History, The Technique of Pottery Making, Clay and Its Preparation, Handwork in Clay, Making Hand Molds, Casting and Pressing in Hand Molds, Working on the Potter's Wheel, Pressing Ware with Revolving Molds, Decorating and Glazing, and Kilns and Their Operation. A glossary is included for the definitions of the most common ceramic terms.

As a source of directions for the teaching of pottery and as a guide to the beginners in this ancient and fascinating art, the book is very useful. To those interested in pottery, whether for home craft, art, or commercial purposes, the book is also helpful.—G. O. O.

Physical & Dynamical Meteorology. By David Brunt. 2d. ed. Cambridge, University press, 1939. 428 pp., illus. Price, 25s/–.

Dynamical meteorology is still in a state of flux. Every year some new theories are developed; some of the older theories are modified or discarded after being tested by the greater abundance of observational data collected. To analyse and to sift from all these theories the elements which promise to be of permanent value, and to collate them into a textbook for graduate students, is no inconsiderable task; yet this is the task the author of this book set before him, and he has succeeded admirably well in carrying out his plan. He has given a good introduction to the various research projects in progress and to the methods used in synthesizing the very unwieldly material furnished by observation into hydrodynamical formulas.

In this, the second, edition of the book, less space is given to the saturation and condensation processes as they would exist in the purely theoretical case of an isolated parcel of air being lifted through a still atmosphere; and more space is used in describing these processes as they actually exist, the nature of condensation nuclei, condensation at less than saturation relative humidity and at temperatures below the freezing point, and on supercooling of water in the atmosphere. Another new addition is the work of Elsasser, Denison, and others who showed that the absorption spectrum of steam is not applicable in the discussion of the absorption of water vapor in the atmosphere. For there the effects of air pressure, water vapor pressure, and temperature are such as to make the tails or wings of the narrow bands of emission become more important and have a larger effect, than the central emission lines themselves. While there

are still many gaps in our knowledge of the mechanism of radiative transfer in the atmosphere, we have now a possible explanation of the fact that the total long-wave radiation from the atmosphere far exceeds the amount that could be obtained from narrow spectral lines of emission separated by wide intervals of complete transparency.

More space is given in this edition to the studies which have been made by the Göttingen school, by Rossby and Montgomery, by Sverdrup, Sutton, and others, on turbulent motion in the atmosphere. One unaccountable omission here is G. Grimminger's determination of the value of the kinematic coefficient of eddy diffusion. His values are of the order of magnitude required to account for the lateral shearing stresses which are set up between two adjacent currents of air in an isentropic layer whenever the gradient wind velocity differs in the two currents. It is the mutual retardation and acceleration of adjacent filaments that accounts for the discrepancies between the actual motion of the air in an isentropic surface and the motion which would be expected from the pressure gradient in the same surface. Much progress has been made in America during the last five years in determining the actual motion of air currents by isentropic analysis of aërological data. It is to be regretted that Mr. Brunt did not find room for an account of this work in his new edition.—L. W. W.

Studies in Earth Movements. By R. G. Lewis. Published by the Author. London, The Enterprise Art Co. 173 pp., illus., front.

Theories of the origin and movements of the earth are considered briefly by the author. The "crust oscillation hypothesis" is proposed as an explanation of the formation of river and sea terraces occurring as relics of the Quarternary period of geologic time. This theme is developed throughout by the author as he seeks to coördinate and explain observations of terrace phenomena.

The constant proportions observed in the elevations of levels in certain series of terraces, types of terrace material, and age determinations of the terraces, lead the author to favor a wave motion as the dynamic force responsible for the terrace development. A plastic substratum carrying a succession of waves of the same wave length, but of amplitude varying by a common factor (as in a damped oscillation) is the envisioned vehicle.

—R. M. C.

Landslides and Related Phenomena. A Study of Mass-Movements of Soil and Rock. By C. F. Stewart Sharpe. New York, Columbia University Press, 1938. 137 pp., illus. Price, $3.

Anyone who has seen the untold destruction which is brought to property, and even life, by large landmass movements, should feel a deep concern over such havoc. The bare scars on the mountain slopes even present greater problems, since the land becomes susceptible to further wastage. Such phenomena are the subject of studies made by Doctor Sharpe for the last fifteen years. Doctor Sharpe examined important localities in the United States and in Canada, where large landmass movements occur, and made an extensive study of the literature covering the subject.

Now Doctor Sharpe has brought together the results of his studies between two covers. The book contains 137 pages of progressive discussions, divided into seven chapters. After reviewing the classifications of landmass movements, which were presented by his predecessors, he offers a new classification.

The various types or processes of landmass movements are discussed in separate chapters (chapters 3, 4, 5). In each type of movement the author pictures in detail to the reader the transition that occurs from moving masses of dry soil and rock to moving soil and rock impregnated with water. His discussions are effectively and appropriately supplemented by diagrams. Pictures are presented to help illustrate the various forms of landmass movements. At the end of each chapter the causes of the movements, in outline form, are enumerated. Chapter 6 is devoted to subsidence and chapter 7 contains the author's conclusions. The voluminous bibliography accompanying the book increases its value.

Soils men, especially those engaged in soil conservation, and the geomorphologist, geologist, and geographer, will give this volume a hearty reception.—J. P. M.

Planets, Stars, and Atoms. By George Edwin Frost. Caldwell, Idaho, The Caxton printers, Ltd., 1939. 287 pp., illus. Price, $3.

This book gives a bird's-eye view of astronomy and nuclear physics. It is written for the layman and reads like a novel. The facts of astronomy are of themselves so breath-taking that a straight-forward, popular presentation of facts such as those contained in this book is bound to hold the reader enthralled. The author first explains very briefly the more important instru-

ments with the help of which the astronomers have made their discoveries. Then he conducts us on a tour through the solar system, explaining the sizes and distances of the planets, and the nature of the tides, eclipses, auroras, and comets. From Pluto, the farthest planet, we jump 24,000,000,000,000 miles to the nearest star,—"It would take an airplane of the fastest type, traveling over 400 miles an hour, about 7,000,000 years to make the same trip, flying constantly at top speed." Yet Proxima Centauri, the nearest star, is only 4.1 light years distant, and before we reach the end of our journey through the known galaxies of stars we must travel a distance of 500,000,000 light years from the earth.—L. W. W.

Land of the Soviets: A Handbook of the U. S. S. R. By Nicholas Mikhailov. Translated from the Russian by Nathalie Rothstein. New York, Lee Furman, Inc., 1939. 351 pp., front., illus. Price, $2.50.

This book is a description of a country covering fully one-sixth of the globe. The information it contains should be authentic and authoritative as the author is considered as one of the foremost geographers of the Union of Soviet Socialist Republics. In a very entertaining style, the author describes a territory of enormous expanse; a country of unusually rich natural resources that are just beginning to be developed extensively; and a land unexcelled in its variety of natural beauty. The more than 175 colorful peoples and tribes that inhabit the Soviet Union under unique economic and social conditions; the extremes in climate; the great variety of topography and the beauty of the land; the vast and rich mineral and vegetable assets throughout the length and breadth of the country; and the rich rivers, lakes, and seas that team with fishes, are vividly and interestingly portrayed.

The author gives a very clear and informative, though concise, account of the social order obtaining in the USSR. He touches briefly on the governmental organization of the eleven sovereign states, and their relation to one another and to the central government of the Union. He describes at length the unbelievably great and rapid strides in the development of industry, agriculture, transportation, foreign trade, and labor, including the world-famous third five-year plan and its prosecution at seemingly clock precision. In his effort to impress upon his reader the remarkable resources and economic advancement achieved by the Soviet Government, the author has utilized freely the ef-

fective medium of comparison, taking the rich and highly developed resources of the equally, if not far more, progressive, powerful, and truly democratic country, the United States of America, as his basis.

The greater part of the book is devoted to detailed descriptions of the eleven equal sovereign states voluntarily united, which form the USSR. These descriptions cover a little of the history, the territorial extent, the millions of patient and industrious inhabitants belonging to no less than 175 peoples and tribes, the abundant natural resources, and the agricultural, industrial, and cultural development of each of these Union Republics. Sections of the country especially rich in the fundamental raw materials are more fully described than others less endowed.

The author has also resorted to the unique and more effective way of emphazising his important points by the insertion of illustrative maps in appropriate portions of his discussions. He has also provided a detailed index for quick reference to any particular subject taken up in the book.

In view of the current world events in which the USSR figures very prominently, this book is a valuable reference for those who want to know the economic, if not the social, conditions obtaining in every corner of that colossal communistic land.

—Q. A. E.

Conservation in the United States. By Members of the Faculty of Cornell University: A. F. Gustafson, H. Ries, C. H. Guise, W. J. Hamilton, jr. Cornell Heights, Ithaca, New York, Comstock publishing Co., Inc., 1939. 445 pp., front., illus. Price, $3.

The same problems that have faced the United States on the conservation of the natural resources that are vital to the life of the nation have also confronted us and are proving quite serious at the present moment. There is no doubt that the United States is several steps ahead of us in handling these problems. Hence, this nontechnical presentation of the subject of conservation should interest anybody who has at heart the perpetuation of the natural wealth of his country.

The book is written by authors distinguished in their own fields. The aim of the book is "to present the basic principles of conservation to the reader so that he may gain an understanding of tomorrow's problems and be in a position to deal effectively with them." The authors have grouped the natural resources of the United States into four; namely, (1) soil and water resources; (2) forest, parks, and grazing lands; (3) wildlife—

fish and game; and (4) mineral resources. They are discussed separately; each part is written by a specialist on the subject. Doctor Gustafson in the introduction discusses the general principles of conservation and how the practices of conservation developed in the United States.

Doctor Gustafson, being a soils expert, wrote Part I, which treats of the conservation of the soil and water resources. Soil is the greatest of all natural resources, and the author dwells lengthily on this subject, touching on formation of the soil, causes of the depletion of its fertility, and wastage through erosion. Of the two forms of soil depletion, he regards erosion as the more serious, because, while fertility can be restored, soil removed by erosion is lost forever. In the closing chapters are enumerated methods of maintenance and improvement of soil fertility and prevention and control of soil erosion.

Part II covers the conservation of forests, parks, and grazing lands. It was written by C. H. Guise, formerly professor of forest management in Cornell University, who describes the original forests of the country, their uses, and the manner in which valuable timberlands were rendered nonproductive. The author also enumerates conservation measures. Two chapters are devoted to parks and grazing lands.

W. S. Hamilton, Jr., assistant professor of zoölogy in the same university, wrote Part III, which deals with the conservation of wild life—fish and game. In the conservation of fishes, he emphasizes the importance of knowing their life habits.

The last part is a discussion by H. Ries, professor of geology, also in Cornell University, who discusses the occurrence, supply, importance, and conservation of the metallic and nonmetallic resources, coal, petroleum, and natural gas. Minerals, unlike the other natural resources discussed in the other three parts, are not renewable.

While the authors have enumerated various methods of conservation and described them briefly, the reader will be disappointed that they do not show how the methods are applied. To cite an example: contour plowing, strip cropping, or terracing is mentioned as a method of preventing and controlling soil erosion. But, as to how each one is carried out is not shown. The authors have limited themselves to showing only the basic principles of conservation.—J. P. M.

Growing Plants without Soil. The A. B. C. of Plant Chemiculture (Soilless Agriculture, Chemiculture, Water Culture, Hydroponics, Tank

Farming, Sand Culture) Including Plant Growth Hormones and Their Use. By D. R. Matlin. New York, Chemical publishing Co., Inc., 1939. 139 pp., front., illus. Price, $2.

The author, in writing this book, has three principal aims; namely: (*a*) to give the latest scientific facts about plant chemiculture in very simple language for the benefit of beginners and students; (*b*) to furnish a practical guide to those who find pleasure in growing plants in tanks, in a greenhouse or in and about the house; and (*c*) to aid people engaged or planning to engage in commercial fields of plant chemiculture.

The contents of the book are based on original experiments and scientific investigations. The first chapter traces the history of soilless gardening. The rest of the chapters treat of the advantages, the functions and the relations of chemicals to plant and animal life, the chemicals needed by plants, the conditions affecting germination, formulas of nutrient solutions, explanation in the use of these formulas as well as the control of tank culture, the construction of tanks, the aëration problem, the determination of exact pH values of the nutrient solutions, and the temperature, humidity, and maintenance of greenhouses.

The book is also distinctive in that all the explanations of the various topics discussed are very clear and easily understandable even by one who has no knowledge of chemistry. The chapter on the advantages of plant chemiculture was well presented despite its brevity. The importance of the quality of food products, of mineralizing the foods, and of the perfection of new products are advanced as the greatest contributions of the science of hydroponics. The economic point of view in chemiculture is well discussed. Another characteristic feature of the book is the fact that the practical aspect of hydroponics is not neglected. Helpful suggestions are included in each chapter. The blending of theory and practice, the up-to-date experiments relating to the subject, and the practical objectives of the author make this book a valuable help to all who are interested in soilless growing of plants.

The book is very well ilustrated.—J. M. M.

Plant Growth-Subtances; Their Chemistry and Applications, With Special Reference to Synthetics. By Hugh Nicol. London, Leonard Hill, Ltd. England, 1938. 106 pp., illus. Price, paper, 5s/6d.

Hugh Nicol in his 108-page paper-bound book "Plant Growth-Substances" gives a concise but clear exposition of the substances that induce growth in plants. Two chapters, written

for the layman, are so worded as to be easily understood. What these substances are, and how to buy, prepare, and use them, is discussed in these chapters.

Methods of the preparation of these substances, either synthetically or otherwise, are given. The modes of application and the growth substances in relation to growth are discussed in the four succeeding chapters. The classification and nomenclature of plant growth substances, their identification and some substances related to them, are well presented and give a very clear concept of hormones. Hormones are also differentiated from plant vitamines. The tabular index makes the book very handy to use by both layman and scientist.

The references after the important chapters add to the usefulness of this book.—M. S. S.

Soybeans, The Wonder Food! A Brief Treatise on Modern Nutrition. By N. A. Ferri. Boston, Bruce Humphries, Inc., 1938. 62 pp., illus. Price, $0.25.

Dr. Charles E. Fearn, who wrote the foreword, considers the appearance of this work of Doctor Ferri on the soybean and its nutritive value particularly opportune and desirable. The ceaseless effort of man to provide the world with sufficient nutritious food occasionally brings out starting results. The treatise presented by Doctor Ferri is brief, but it includes an extensive survey of the uses of the soybean. Doctor Ferri points out in plain terms not only the food values of the soybean but also its importance to the fundamental problem of improving individual and national nutrition. His concise but instructive discussions on the soybean industry, the economics of nutrition, the protein of soybean, the soybean mineral contents, the vitamin and the soybean, making dairy products with soybean, and special soybean recipes should interest the dietitian and the thoughtful housewife.—A. O. C.

Health and Nutrition in India. By N. Gangulee. With a Foreword by Sir John Orr. London, Faber and Faber Ltd., 1938. 337 pp., illus. Price, 15s/–.

Professor Gangulee's book presents conditions that find many parallels in the Philippines. The early chapters deal with general principles and recent advances in the science of nutrition. Then follows a discussion on subnutrition and its varied manifestations among the great masses of the population in India, such as high maternal and infant mortality, high incidence of pulmonary tuberculosis, poor physique, and prevalence of deficiency diseases. Then comes a description of the Indian dietary

and its principal defects, which strangely enough, are also the defects of the Filipino diet; namely, lack of sufficient proteins, minerals, and the protective foods. Suggestions are offered for improvement, but the author clearly states that the problem is "no longer medical, but social and economic." Thus throughout the book a great deal of emphasis is put on the economic and social aspects of the problem. The book is a scientific presentation in a simple language that a layman can readily understand. For the author particularly addresses his book to the "leaders of Indian public life" upon whom he urges a "case for immediate action." The book should be read by those leaders in the Philippines who have in their power the shaping of government economic, agricultural, and industrial policies.—N. C.

Handbook of the Vaccine Treatment of Chronic Rheumatic Diseases. By H. Warren Crowe. 3d. ed. London, Oxford university press, 1939. 95 pp. Price, 3s/6d.

This book covers the author's studies and experiences in rheumatic diseases for the last thirty years. A brief discussion is given on the etiology, pathology, and the diagnosis of the disease.

The author's line of treatment is based on the hypothesis that all rheumatic affections are of bacterial origin. He discussed the failures of other workers on the use of stock and autogenous vaccines in the treatment of these diseases. The book gives the procedure of isolating and identifying the different types of microörganisms that may be regarded as the etiologic factor. The author gives the method of preparing the stock and autogenous vaccines, and his procedure of administering them.

Very encouraging results are reported with the use of vaccine therapy. The following may be quoted from the author's conclusion:

> In very many cases, especially early ones, the treatment is perfectly simple, easy, and straightforward. Stock vaccines are efficient in clearing up the condition. It is not too much to say that nine cases of rheumatism in every ten, if treated when the symptoms first appear, would be perfectly well again after a short course of treatment. And the methods here described of attacking arthritis in its early stages should soon be so successful that failure to prevent crippling will be ascribed to pure negligence, just as would now an epidemic of scurvy or typhus fever.

This book will prove interesting not only to orthopædic surgeons and general practitioners but also to laboratory men who may undertake the preparation of vaccines for the treatment of rheumatic diseases.—A. P. R.

Handbook on Tuberculosis for Public Health Nurses. By Violet H. Hodgson. New York City, National Tuberculosis Association, 1939. 92 pp. Price, paper, $0.50.

This handbook briefly and clearly describes different aspects of pulmonary tuberculosis that must be understood for the proper and efficient performance of the duties of a public health nurse. It also gives advice and instructions on the proper conduct that a public health nurse should always strive to maintain in her relationship with patients and their families and also with physicians. It stresses the value of the nursing service in the treatment and prevention of tuberculosis.—W. V.

Pulmonary Tuberculosis in Adults and Children. By James Alexander Miller and Arvid Wallgren. New York—Edinburgh, Thomas Nelson & Sons, 1939. 200 pp., illus. Price, $3.50.

This book is a concise but comprehensive exposition of tuberculosis. Fundamental, often controversial, concepts of contact and infection, allergy and immunity, resistance and dissemination are vividly presented in a simple logical manner. The evolution of tuberculosis, with all its varied phases of progression, inactivity, arrest, reactivation, and exacerbation, is traced from the stage of primary infection to that of terminal phthisis. Morbid anatomy, symptomatology, diagnosis, treatment, and prognosis are briefly discussed in relation to the different stages. The all-important topic of prevention is premised on sound pathogenetic principles. The authors' cautious and conservative attitude to the clinical appraisal and management of tuberculosis, and their balanced view with respect to the relative importance of the clinical history, physical examination, roentgen exploration, sputum examination, red-cell sedimentation, and immunobiologic tests, certainly makes for sanity in these days of overemphasis on radiography and collapsotherapy. The book is a valuable source of information for the general medical practitioner and a good reference for the public-health physician. What it lacks in detail is more than compensated for by its practical and clear presentation of the subject matter and by its extensive bibliography.—W. V.

A Symposium on the Blood and Blood-Forming Organs. By E. Meulengracht and others. Madison, The University of Wisconsin press, 1939. 264 pp., illus. Price, $3.50.

The material presented in this book is the subject matter of a symposium on the blood and blood-forming organs held under the auspices of the University of Wisconsin Medical School, September 4 to 6, 1939. It covers the most up-to-date facts on blood

diseases, including changes in the blood-forming organs or tissues. It not only deals extensively with hæmatological and bone-marrow changes in blood dyscrasias but also opens several avenues of research in hæmatology both in the peripheral blood and in the bone marrow. While the book may not appear attractive to the general practitioner, it is indispensable to the pathologist, clinical pathologist, and the internist interested in blood dyscrasias.—R. J. N.

Disorders of the Blood. Diagnosis, Pathology, Treatment and Technique. By Lionel E. H. Whitby and C. J. C. Britton. Philadelphia, P. Blakiston's Son & Co., Inc., 1935. 543 pp., front., illus. Price, $7.

This book is a real text on disorders of the blood, for it includes not only diseases originating from the blood and blood-forming organs but also diseases originating elsewhere but producing marked changes in the blood. It should be a handy reference even for the busy practitioner as each disease and condition described contains a section on treatment. The chapters on the Principles and Practice of Hæmatological Diagnosis are well presented and afford a basis for the hæmatologic diagnosis of the many conditions described in the text. The summaries at the end of practically every chapter are features especially welcomed by the practitioner.—R. J. N.

Woman: that eternally supreme question answered by E. N. Kurtz. Boston, Meador Pub. Co., 1938. 436 pp.

The author discusses the fundamental principles of the two sexes. He reviews the position of woman in creation through all the ages since Eden—from the disobedient wife of Adam to our "Red hot mammas" of today.

While the author does not attack woman discriminately, yet he attacks feminine rebellion, forms of feminism and other agencies which are responsible for making woman a competitor instead of a helpmeet of man. The chapters on social disorders, sex antagonism, negative knowledge of woman, the fifty-fifty fallacy, prohibition, and materialism are entertaining.

This book is packed with quotations from the Bible. Mr. Kurtz has devoted considerable space to the science of religion, history, psychology, and philosophy in answering "man's eternal cross and question—woman." The study of woman as "the first labor scab" and of women as "natural thieves" are enlivening if not misunderstood as a ridicule or a persecution.

This book should have a universal appeal to both men and women.—L. R.

RECEIVED

ALSTON, A. H. G. The Kandy flora. Colombo, Ceylon government press, 1938. 109 pp., illus. Price, Rs. 3.50.

Canned food facts. New York City, American can company. 71 pp., illus.

CHIBNALL, ALBERT CHARLES. Protein metabolism in the plant. New Haven, Yale university press, 1939. 306 pp., illus. Price, $4.

FROST, GEORGE EDWIN. Planets, stars, and atoms. Caldwell, Idaho, The Caxton printers, ltd., 1939. 287 pp., illus., front. Price, $3.

GRAUMONT, RAOUL, and JOHN HENSEL. Encyclopedia of knots and fancy rope work. New York, Cornell maritime press, inc., 1939. 615 pp., illus., front. Price, $10.

NADLER, MAURICE. Modern agricultural mathematics. New York, Orange Judd publishing co., inc., 1940. 315 pp., illus. Price, $2.

PEARSE, N. S. Cotton progress in Brazil. Manchester, Henry Blacklock & co., ltd. 183 pp., illus.

SUTERMEISTER, EDWIN, and F. L. BROWNE. Casein and its industrial applications. New York, Reinhold publishing corporation, 1939. 433 pp., illus., front. Price, $6.50.

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PHILIPPINE LAND MAMMALS. By Edward H. Taylor. Order No. 490 Bureau of Science Monograph 30. Paper, 548 pages, 25 plates and 25 text figures. Price, $2.50 United States currency, postpaid.

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